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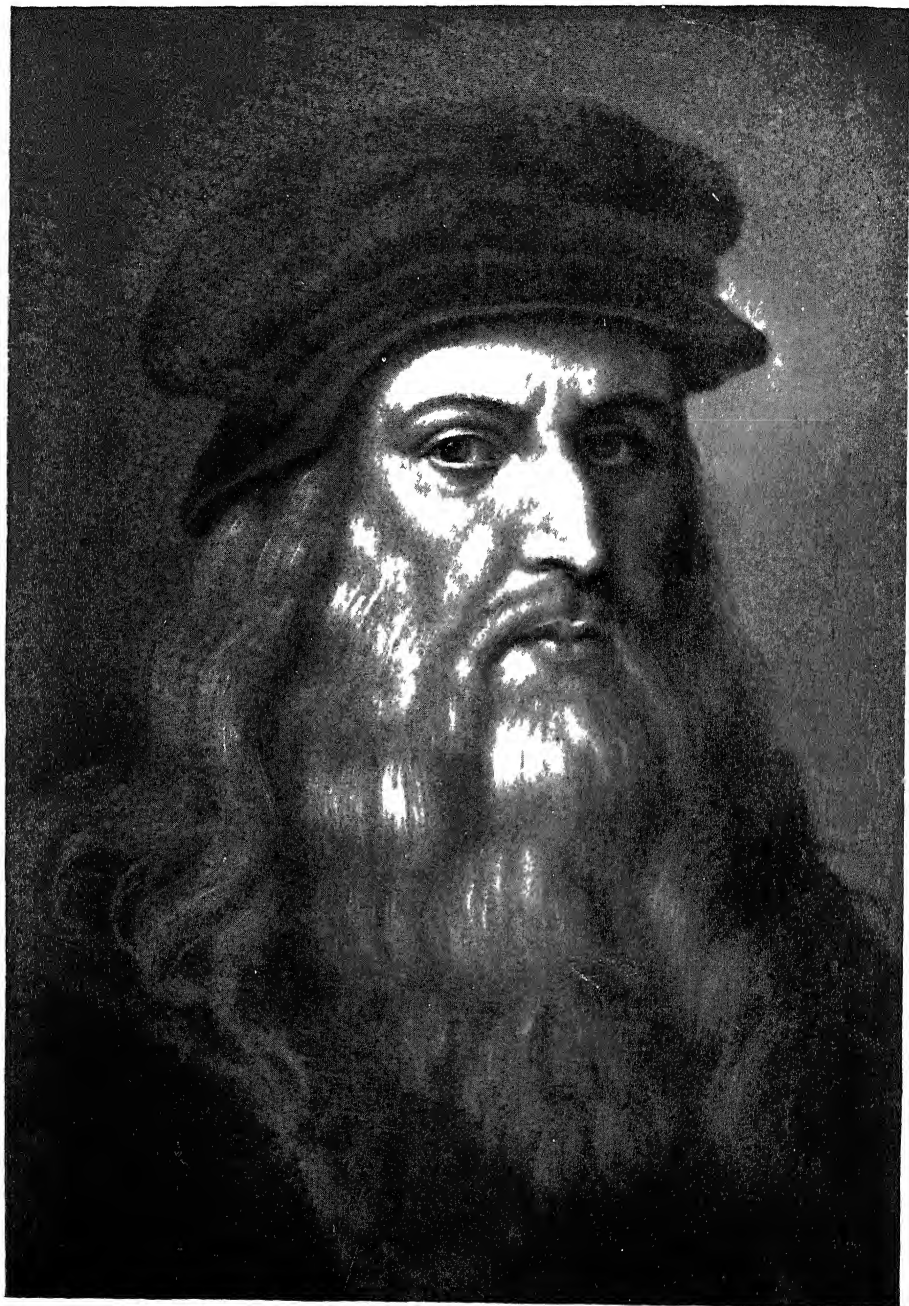
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MAN WITH WINGS





LEONARDO DA VINCI

MAN WITH WINGS

The Story of Leonardo da Vinci

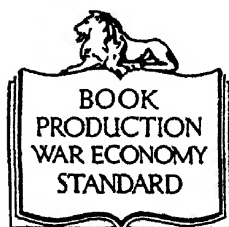
BY
JOSEPH COTTLER



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THIS BOOK IS PRODUCED
IN COMPLETE CONFORMITY WITH THE
AUTHORIZED ECONOMY STANDARDS

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CHAPTER ONE

Man with a Notebook

THERE is a picture painted on a wall inside a church in Milan. Dim and cracked by the centuries, this picture would long ago have faded from sight had it not from age to age been restored and cared for. Hardly a glimmer of its original colour is left, and of its form only the bare outline. Of the artist there was remembered until recently only the name—Leonardo da Vinci. Another picture, treasured in a Paris museum, bore the same name, and these two works of art surviving a succession of emperors, revolutions, and tastes, kept at least the memory of the artist alive. But it was dim and legendary, like the picture on the wall inside the church.

Legend pointed back to an eccentric character who had dabbled in all things, including the black arts; an inventor of magical contraptions; a man obsessed with the mad belief that he could fly. That no more exquisite painter ever lived was no legend, for although many of his pictures seemed to be lost, those at hand were proof enough of his genius. There the matter rested for about three hundred years, until through the mist of legend and hearsay the authentic voice of the man himself was heard.

It happened that a few learned men had noticed pages of strange old manuscripts scattered among the dusty relics of Europe. The odd thing that connected certain pages found in a library in Paris with others in London, Milan, or Vienna, was their reversed script. Whoever the author, it seemed that he had intended his work to be read in a mirror. The stray manuscripts had blown about in all the gusts of three centuries, and scarcely anyone had tried to read them. That they had escaped the rubbish heap was due only to that instinct which preserves in attics rickety chairs and bundles of old letters.

At length scholars held up their mirrors to the dusty pages.

They expected to find nothing more than curiosities. But, stripped of disguise, the manuscripts came to unfold nothing less than a discovery of the Universe. Many of the pages were illustrated, and the lines of some of the sketches bore a faint resemblance to the pictures in the Milan church and the Paris museum. Often the author spoke personally. *I, Leonardo da Vinci*, he wrote. When the scholars had deciphered and piled up some five thousand pages, there emerged through them one of the most powerful minds in human record.

The pity was that the manuscripts had not come to light earlier. Leonardo's pictures, once well known, had changed the course of art. Had his notebooks been as well known, they would have changed the course of science. The world would not have had to wait for Copernicus, for Galileo, for William Harvey, and for a line of later scientists whose discoveries he foretold.

Among people ridden by the fear of witches and the hope of miracles, his mind had dwelt upon cameras, motor-cars, and aeroplane propellers. Among soldiers who sallied forth to do battle with pikestaffs, he designed a tank and a submarine. He discovered for himself streamlining, roller-bearings, brakes, transmission gears, and much of the technology of a later day. But of all his machines—and he invented almost three hundred of them—he gave most thought to the aeroplane. His was a twentieth-century soul strayed into the fifteenth.

Who, we ask, was this Titan of a man? If we follow all the clues we shall trace him back to his home in Italy almost five hundred years ago. Let us go back to the city of Florence on the Sunday before Ascension Day, 1478.

While all Florence was on its knees in prayer that Sunday, the bells of the old Palace pealed out an alarm: 'Conspiracy against the republic! All loyal citizens to the Piazza!'

Immediately a shout of "*Palle! Palle!*"—the cry of the Medici, the first family in the city—swept through the streets as loyal partisans rushed to the square. Once there, they hurled not only cries but stones as well at a hundred armed men, hired by the Pazzi family, who were shouting, "Liberty! Down with the tyrants! Down with the Medici!"

In the end the gilded *palle*, emblem of the Medici, was victorious. Giuliano de' Medici had fallen by the assassin's dagger, but fortunately Lorenzo, head of the bank and the republic's leading citizen, had escaped with but a wound.

When the fighting was over Lorenzo stepped out on the balcony of his palace, and, pressing his wounded arm against his side, spoke to the shouting mob below. "I am alive," he said, "but my own safety is nothing. The safety of the republic means more to me than life. Be merciful to the traitors who have attacked me."

The crowd cheered wildly and proceeded to hang the prisoners on the spot. But the murderer of Giuliano was not to be found.

Almost two years later, in December, 1479, the long arm of the bank of the Medici caught him. Outside one of the upper windows of the public palace the body of a man quivered at the end of a rope. All through the December day the heavy twists of rope sported with the thing. The drooping head was topped by a modish cap, and the body was clad as if by the hangman's humour in a fur-lined cloak. The Piazza was crowded. The weaver had abandoned his loom, the jeweller his bench, the friar his cloister. Everyone in Florence raised his eyes to the final act of the drama.

Under those dangling feet the terror of that Sunday before Ascension Day was revived. People spoke warmly of Lorenzo's generosity. They spoke with passion of the Pazzi family, which had led the conspiracy. They gesticulated towards the aimless body at the end of the rope.

The only spot of calm was where there stood a man with a notebook in his hand. He was tall, with narrow hips and powerful shoulders accentuated by a short, rose-coloured tunic. A cloud of light-brown hair swept back from his broad forehead. His nose was straight and strong, his mouth firm, and his chin square. Serenely sketching, he stood apart from the throng. One often saw him sketching or taking notes in his uncanny way with his left hand, writing from right to left, as though his words were meant to be read only in a mirror.

One came upon him frequently at scenes like this, near the scaffold or among the sick at the hospital of Santa Maria Nuova.

Only the day before he had sat in the hospital and talked with an old man whose skin was like dry parchment. Wherever there were twitching mouths and terrified eyes, there one might meet the inscrutable Leonardo da Vinci, always with his notebook. Anyone who had strayed too near the witches' grottoes at sundown, and had to scramble down the hillside before the new moon rose, was likely to meet him wandering among the rocks, with his eyes fixed on the wheeling hawk. His concern with birds of every breed was well known. Did he read the secrets that the birds wrote across the sky?

One came upon him in the markets by the bird-sellers' stands, lithe and elegant in his rose-coloured tunic. He walked about watching the larks, the thrushes, and the swallows hopping in their cages. On occasion he went off with a cage under his arm. Sometimes he opened the cage, gently took out the bird, and with a caress released it. One might have thought it his own soul going to paradise, or that he read the future in the flight of birds, so intent he stood. Whatever the message of those beating wings, he never failed to record it in the notebook that he drew from his tunic.

Leonardo was no stranger in Florence. His father, Piero the notary, had brought him from Vinci ten years ago. The youth, then sixteen years old, was at once put to work in the shop of the artist Verrocchio. Gossip in the square told how shortly afterwards he displayed such talent that his teacher Verrocchio—he who made the graceful bronze of the Biblical David for the public palace—laid down his brush and vowed never to use it again. It happened that Verrocchio had been commissioned to paint a Baptism of Christ. To save time he gave over a part of the canvas to Leonardo, to paint in it a little angel. When Leonardo had finished there was a little miracle, an angel such as had never been seen before, and in the background a vision of misty hills and gleaming pools. At that Verrocchio, yes, even he who had made the great ball of copper and hoisted it to the top of the Duomo, laid down his brush, vowing never to use it again. . . . A legend? Ah, but legends have a basis, which is truth.

There were also heard stories of Leonardo's physical strength. His hands were white and tender but he could bend a horseshoe

apart with them or, wrapping cloths round a stout blade, break it in two. Once a horse charged furiously past him, and—so goes the story—he caught the reins of the charger and stopped it in its tracks. He had muscles as powerful as steel and as precise as pins. Nobody in Florence could play and sing as well as Leonardo. He fashioned his own lutes and shaped them in fanciful ways, one like the skull of a horse, another like the belly of a fish. Lorenzo de' Medici, it was said, counted Leonardo not among painters but among musicians.

As he stood there sketching he cast a sweet, tranquillizing spell. Not that his handsome face showed any pity for the hanged man. Indifference perhaps. In the midst of the tumult of the square he stood aloof. But as he fixed the scene of death upon the page of his notebook he seemed to bring peace to the heart of it.

Someone shouted, "Let this be a lesson to the Pazzi family, which has plotted against the life of our Lorenzo!"

Another added, "He was a scoundrel. He must not be buried in holy ground, or it will bring down upon us the wrath of heaven, a deluge, or a famine, or the plague."

Leonardo's eyes were fixed on the heavy lines of the speaker's brows, and the jutting curve of the jaw.

There were those in the square who glanced at the hanging body, crossed themselves, and hurried away. Leonardo seemed to see only its lines and angles. When he had composed these, and touched them with a little beauty, he too turned away.

The square was lively, as always, its talk flowing round the stone benches and in the doorways of the churches.

"He must not be buried in holy ground. . . . Dante says, 'Love moves the stars in their courses'. . . . The peace which Lorenzo has made with the Pope will not last. . . ."

Leonardo made a quick note of the speaker. His pencil dwelt upon the exclaiming forefinger, upon the angle of the head, upon the ellipse of the mouth.

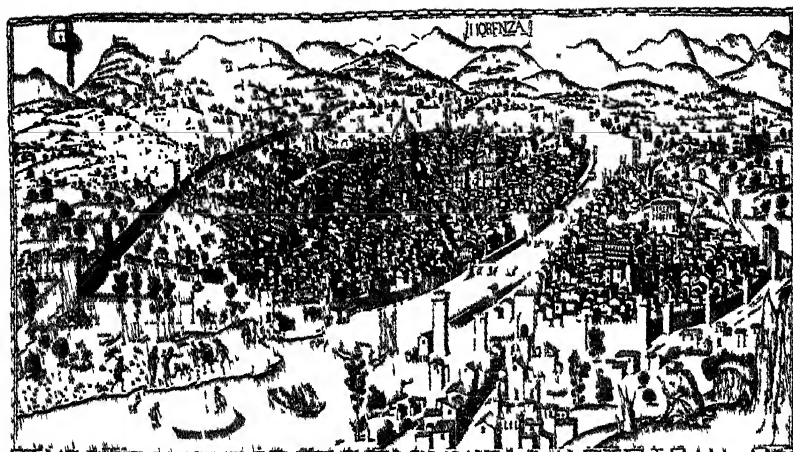
In the market he stopped at the bird-seller's stall to look at a swallow.

"He loves the little birds," thought the bird-seller. "Or does he foretell the future?"

Leonardo drew the bird out of its cage and ran his fingers through the slim plumage. He felt the rigid roots of the feathers, the downy tips. He drew out the long span of wing and stroked its under-side. Slowly he let go. The bird leaped frantically.

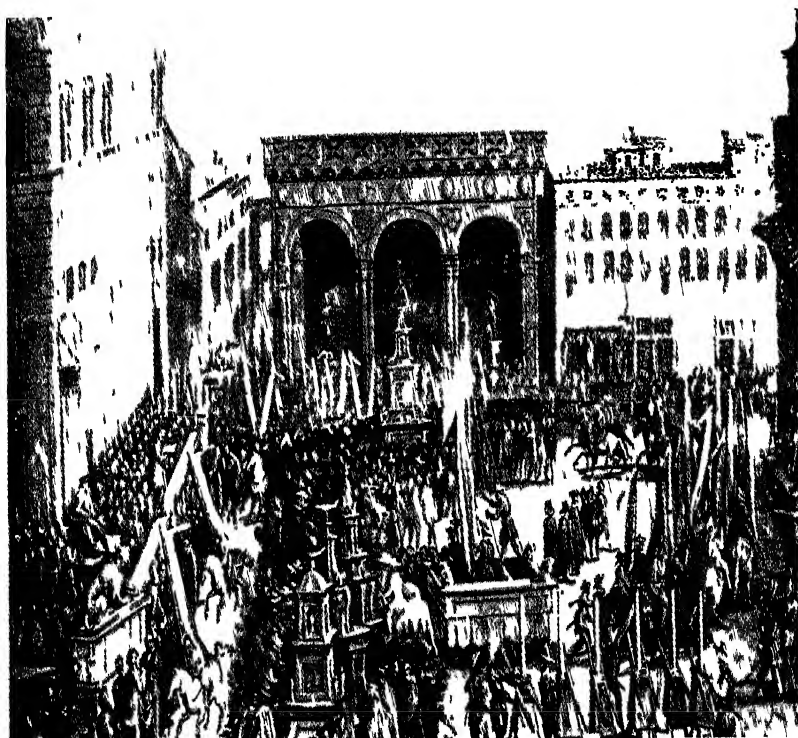
At the Piazza di San Marco he turned into the garden of the Medici. It was crowded with people and statues. Lorenzo de' Medici had furnished it handsomely with pieces of sculpture, especially ancient sculpture, for things antique were very fashionable; but Leonardo wasted no time on the marble furnishings of the garden, though in passing he stopped to take note of a tree.

The way to Verrocchio's shop took him past palatial courtyards hung with tapestries, until at length he came to the river. He stopped a moment on the bridge to look down into the greenish water. Off the bank the current eddied and swirled. A twig floated past and was caught up in a cross-current. It trembled and plunged underneath. Why? What compelled it? By what necessity did those waters swirl as they did? Waves of water, waves of air. What laws governed the moving waters and the moving air, birds, or twigs! His tall, spare figure cast its shadow on the tinted surface. He took out his notebook, wrote awhile, and went on to the shop.



FLORENCE

(Anonymous fifteenth century Woodcut)



Mural by Giovanni Stradano in the Palazzo Vecchio Florence

p 14

DEDICATION FESTIVAL IN FRONT OF THE LOGGIA DE' LANZI, FLORENCE



HEAD OF A WARRIOR (c. 1475)

CHAPTER TWO

The Shop

LEONARDO had been part of the shop ever since his seventeenth year, when his father brought him down from the village of Vinci and presented him to Andrea del Verrocchio. Verrocchio was then a man of about thirty-five, but, apart from the sharp eye which gave rise to his nickname, and the thin, determined mouth, there was something about him for ever youthful. The boy Leonardo sensed it in the broad brow raised in an unrelaxed inquiry, and in the round, double-chinned face.

The master was at once drawn to his new, curly-headed apprentice from Vinci. Verrocchio had other pupil apprentices. He liked Perugino, the young man from Perugia, who had a clever way with the brush; he watched with satisfaction the promise of little Lorenzo di Credi. But to Leonardo alone his devotion was without reserve, a devotion that for both became stronger than that to their own kin—for Leonardo went to live in Verrocchio's house. It was stronger even than self-interest, for when, at the age of twenty, Leonardo was no longer an apprentice but a member of the guild of painters with every right to set up a shop for himself, he still stuck to the shop of Verrocchio.

The shop had a good trade—the liveliest in Florence. Much of it was work on household articles. The good signora whose husband had had a profitable year in the wool business required smart silver plate, a few platters and cups with which to dazzle her neighbours. A friend of hers needed a carved lid for a linen-chest. One day it was a lute, another a coverlet for a bed that Verrocchio made. The people of Florence found that they could rely on him for any article of fancy. If one wanted the best workmanship, Verrocchio's shop was the place to get it. The princely Medici, always on the look-out for artists to glorify

their family, were customers of Verrocchio. For the coming joust, Giuliano de' Medici ordered a helmet decorated with the face of his latest sweetheart; Lorenzo might require a metal screen for the tomb of his father, or a diplomatic gift of arms and standards for the Duke of Milan.

But the shop's most frequent clients were the churches. The most beautiful act of man, said the priests, was his worship of God. Should this act be performed with mean furniture? How could the Church hope to keep the hearts of its people and to win converts if its ways were ugly and austere? Should Verrocchio make helmets and screens for the Medici, and not pyxes and brooches for the Church? Should he depict soldiers and lovers, and not the loveliness of Mary and the passion of Christ?

Verrocchio's shop became the busiest in Florence, and Leonardo worked with all manner of tools and materials. He learned to hammer, to file, to solder. When Verrocchio was commissioned to make a huge ball in bronze and to fix it above the cupola of the cathedral, Leonardo helped to pour the molten copper into the mould, and to rig up the hoisting tackle. What Verrocchio valued in his young apprentice from Vinci was that he could be trusted to handle all the materials of the shop. If there was a little modelling to do, some trifle of a child's head perhaps, Leonardo took the greatest pains to get the drawing accurate, to mix his clay to the right density, and to model it with taste. His drawing was masterly, for he had followed Verrocchio's advice that draughtsmanship was the necessary basis for an artistic career.

About two years after Leonardo had come to the shop Verrocchio, pressed for time, tried him on a few parts in a picture for an altar. The picture was to show the Baptism as it is suggested in the Gospel according to Saint Luke:

Now when all the people were baptized, it came to pass that Jesus also being baptized, and praying, the heaven was opened, and the Holy Ghost descended in a bodily shape like a dove upon him. . . .

The work was long overdue and the convent was complaining. Verrocchio brought out the unfinished picture. The two central figures of Jesus and John and the foreground had been put in. The two angels and the background were still to be done.



Valle d'Arno

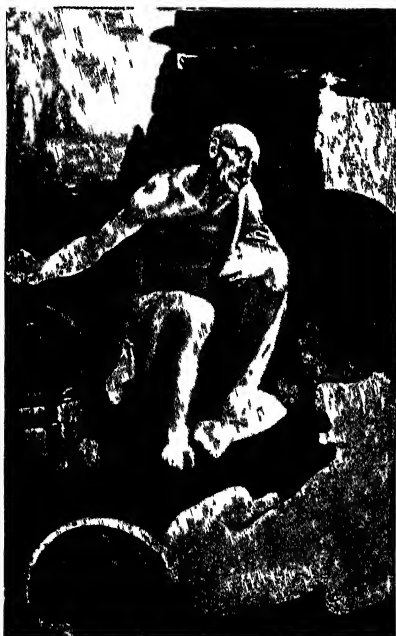


Photo by Anderson



VAL D'ARNO (1473)

SAINT JEROME (c. 1483)

STUDY FOR "THE MADONNA
WITH THE CAT" (c. 1478)



STUDY FOR THE ADORATION
OF THE MAGI (c 1480)



THE ADORATION OF THE MAGI (1481-1482)

"Now watch," he said to Leonardo as he painted in one of the angels. He worked rapidly over the full, childish face. "Make the other angel, Leonardo, and the background." So saying he turned to another job.

The apprentice began to work. Verrocchio hoped for a good imitation of his own brushwork. But it is said that when Leonardo at last turned the Baptism towards him, Verrocchio saw at a glance that he need not be bothered in future with the trade in pictures. This brilliant assistant was capable of handling that part of the work. His own little angel had the features of any good-looking child in the streets of the city—his Jesus and John, with their scrawny legs and unkempt heads, were in fact based on real models—but Leonardo's angel looked as though he had strayed into this world of real people from another, an ideal world. Verrocchio had never seen such hair, which rippled in a torrent over the angel's shoulder, nor such a landscape as that in the background. Other artists brought nature into a picture only to fill in the empty spaces—they put a neat rock here and a stiff tree there. But Leonardo's feeling for rocks and trees was deep and passionate, and out of the depths of his passion he had brought up this vision of flowing water and misty light. Verrocchio was delighted. Now he could apply himself exclusively to sculpture and put Leonardo in charge of the paintings.

In the next few pictures upon which Leonardo worked, Verrocchio was again startled by his handling of landscapes. How did one so young come by such understanding? Nature had revealed herself strangely to the soul of the boy of Vinci, he thought. For by this twilight and these windswept trees Leonardo seemed to evoke days gone by. One did not suspect a deep side to his nature when he was gay and golden among his friends, singing to the accompaniment of his lyre. An athlete as beautiful as an antique statue of a god, why should he be racked with thought? Yet when he touched the altar-pieces ordered at the shop they became restless with hills and changing lights and wild grasses. Once he showed Verrocchio a drawing with no figures in it, either human or divine. Only landscape. Nobody had ever before done a landscape, and in the shop they looked upon it as a curiosity. The favourite painter of Lorenzo de' Medici,

Sandro Botticelli, calling in one day, remarked that landscape painting was not art.

"Anyone can paint a landscape. All you have to do," said Botticelli, "is to throw a sponge full of different colours at a wall."

To which Leonardo retorted, "Some people paint everything that way."

The artists who dropped into the shop came to exchange ideas and technical gossip. One told how he had spoiled a picture because he failed to peel the thin skin off the walnut kernels from which he made his oil. Another advised oil made from mustard seeds. Leonardo stood by, his large eyes upon each speaker in turn. He took note of recipes for colours and varnish; of the way to prepare a surface and the way to grind enamel; of whatever in the talk seemed to him good.

What he found especially good was talk of the human body. Verrocchio insisted that all modelling or painting should be done from life. Most artists did not adopt this method, but in Verrocchio's shop could be found clay models of arms, legs, and torsos. A huge diagram of a horse hung on one wall, and on another that of a man. The students learned that the ear was as long as the nose, that the space between the line of the mouth and the beginning of the nose was the seventh part of the face, and other helpful hints, the moral of which was: *Be faithful to Nature*.

Among those who came to the shop was the sculptor Antonio Pollaiuolo, whose statue of Hercules and Antaeus, done in bronze for Lorenzo, showed a remarkable knowledge of human anatomy. The artist had selected the moment when Hercules lifted his antagonist off the ground in a death grip. He had modelled the tension of the muscles and sinews almost as palpably as though the figures had been skinned. Pollaiuolo did, in fact, dissect human bodies. The citizens of Florence were repelled by the mention of the fact. There were laws of man and God against it, they protested; and even artists said that there was no need to bring such horrors into the lovely garden of art. But Pollaiuolo declared that it was not possible to depict the human body without knowing its structure.

Leonardo sided with him. And, if to anyone, he would certainly tell his neighbour Antonio Pollaiuolo of his visits to the hospital at Santa Maria Nuova and of his own dissections.

"Do you know, Signor Antonio," Leonardo said, "when a man is standing with his arm outstretched, the arm will be somewhat shorter if the palm of the hand is turned towards the ground than if it is turned towards the sky? I dissected an arm yesterday and counted thirty pieces of bone, three in the arm itself and twenty-seven in the hand. Well, there are two bones between the hand and the elbow, and when you turn the palm down, they intersect in such a way that the one on the outer side of the forearm crosses obliquely over the bone on the inner side."

Once he said: "Yesterday at the hospital I spoke with an old man whose skin was like dry parchment. He complained of nothing but weakness and cold. He died, and when I made an autopsy upon him I saw the reason for his cold and weakness and squeaking voice. The trachea, the colon, and all the other intestines were quite constricted. In the veins which pass beneath the fork of the breast I found stones as big as chestnuts. They looked like clinkers of iron hanging from the veins. The arteries were thick, and some of them were closed altogether. I think the aged are cold and weak because they are starved of blood which cannot flow easily through the blocked passages. Doctors say that is because the blood gets thick with age, but they are mistaken."

The old man not only helped young Leonardo to discover what nobody had ever before known, the hardening of arteries, but served as a model for one of his pictures. The subject of the picture was Hieronymus, a man who had lived in the fourth century and been canonized by the Church as Saint Jerome. In his youth Hieronymus had been a scholar and a gentleman. Suddenly, after a long illness, he renounced the world and the flesh and became a hermit in the wastes of Chalcis where he meditated upon death and the thereafter.

Had Leonardo been interested in making money he would have depicted the saintliness of Jerome. He would have shown an appealing figure in an atmosphere of sweet peace, blessed by

hovering angels of hope. So his friend Perugino or any artist with his eye on sales and profits would have handled the work.

But Leonardo preferred to show the dark side of his subject, the ravages of age and suffering. Hieronymus is crouching in a cave, his withered body modelled by the light that comes through the mouth of the cave. The old man is tense with agony. His mouth twitches in an outcry. The bones of his frame stick out as bare as the rocks in the desert behind him, and the sinews are like cords straining in an effort to hold the frame together. At his feet the artist has put a lion, whose form, sleek and alert, leads up to the dramatic shape of the martyr. For his picture of *Saint Jerome* Leonardo had merely laid aside the dissecting knife and taken up the brush.

The kindly old Paolo Uccello occasionally came into the shop. Leonardo must often have talked privately with him, if for no other reason than that Uccello was a painter of birds. That was why he was called *Uccello*, 'bird.' And if to anyone, it would be to him that Leonardo would confide his studies of flying things.

Speaking of wings, Leonardo would ask: "Do you know, Signore, why those feathers that are farthest from their points of attachment are also most flexible?"

"I know of no reason."

"Is it not because then the tips will be higher than the roots?"

"What then?"

"Then we may suppose that the bones of the wings will be the lowest part of the wing when the wing is lowered, and highest when the wing is raised."

"Why do you suppose that, Leonardo?"

"Because in all motion the heavier part is the guide. Does not Aristotle find it so? At least I have heard Master John Argyropulus quoting this in his lectures on Aristotle. I have borrowed a translation of Archimedes and will look there for light on this rule."

With such authority Uccello would rest satisfied. A close student of geometry, the old man always demanded proof. One branch of geometry—perspective—even excited him to fever-pitch, and whenever he came to the shop he made it the topic of conversation.

To tell the truth, not everyone in the shop was interested in perspective. It was new, newfangled to some, no part of an artist's business. Sandro Botticelli was frankly bored by it. Perugino listened with one ear cocked sufficiently for any useful information he could pick up, but no further. When the argument turned on the point: do we see a tree because our eye shoots a beam of light to the tree, or because the tree sends out beams which strike our eyes?—then Perugino ceased to listen. To him the question seemed of no practical use. He was paid to paint saints and he could paint them just as well either way. But he listened carefully when Leonardo explained it.

"Perspective? It is as though we see an object behind a sheet of glass. The object reflects the rays of light in diagonal lines towards the eye. The sheet of glass cuts the lines, and on its transparent surface we mark the object."

To this advice Perugino might well listen. It would help him to transfer an object, not to a sheet of glass, but to his canvas. Perhaps this newfangled science of perspective was of practical use after all. When one tried to picture a saint who had three dimensions on a canvas which had only two, one had serious trouble.

"We painters have to make flat surfaces appear round," Leonardo insisted. "We can do it only by careful shading and by correct perspective."

At this, many of his friends looked blank. Sandro Botticelli laughed. He was the most popular painter in Florence and was quite satisfied with his popularity. "Why should I rack my brains with geometrical problems?" he argued. "I am a painter. My business is with colour, with the fragrant hues of spring, with the rose on the cheek of a girl, and with the billowy snow of a cloud."

Leonardo pointed to his pen-and-ink landscape. The drawing showed a distant plain of the countryside as seen from a hill. "Sandro," he demanded, "why does this clump of trees seem lower than that house?"

Botticelli dismissed the subject.

But in the shop they liked to hear of the wonder of perspective and the curious behaviour of light; of how as one looked along

a ploughed field the parallel furrows seemed to come together to a common point in the distance; of how two horses running on parallel tracks seemed to converge at the vanishing-point. Leonardo once placed two mirrors opposite each other and, by placing a lighted candle between the mirrors, amazed his friends with the reflexion of two long lines of numberless candles, each candle larger than the one behind it. He placed a number of mirrors in a circle and showed the maze of reflexions in each.

Perugino felt that Leonardo was wasting time. He himself was interested in perspective, but reasonably so—as far as it could help him to paint higher-priced pictures. But here was Leonardo going about the room with a lighted candle, projecting shadows against the wall from this spot and that, measuring angles and the size of the shadows, and recording the results in his notebook. That was carrying a good thing too far. Leonardo, in fact, let it carry him away from the easel, out of the shop, into the larger field of geometry and natural science. Yes, and a painter should know some anatomy. It saved time to know that the ear was as long as the nose, and things like that about the human body. But here again Leonardo was wayward. He was led to the dissecting-room, away from the appearance of the body to the causes for the appearance. Now what good would all that do him?

He had genius, his friends agreed. But it was thwarted, they felt, by an unprofitable curiosity which kept him poor. He was so poor that, when he was admitted to the guild of painters in his twentieth year, he had not sufficient money to pay his entrance fee. At the age of twenty-seven he was no better off. Perugino, without the genius of Leonardo, was getting rich by turning out, for any church that paid him, batches of angels with upturned eyes and—oh!—such sweetness. But Leonardo did not seem to mind his poverty. He was in fact not poor, he protested. "He alone is poor who has many desires," he said.

To a patron of the arts like Lorenzo de' Medici it was exasperating not to be able to buy the work of genius. He heard about the magic hand of Leonardo, both with brush and plectrum. For music Lorenzo had little use. The Duke of Milan made

music his chief delight, but Lorenzo of Florence wanted durable ornaments: a picture, a statue, a poem engraved on parchment. And if golden ducats would not attract a man of talent, Lorenzo forgot him. The youth from Vinci was the most beautiful in Florence, and a skilful musician. He had a charming wit—that was apparent—but at twenty-seven what had he accomplished, this chaser of shadows, this student of cadavers, this watcher of birds, this neglecter of his art? One or two altar-pieces, a few clay heads, a portrait of a young woman. Nothing else.

Lorenzo de' Medici, called *Il Magnifico*, was a man of taste. He enjoyed fine things and fine people. Occasionally he even turned out a poem with his own pen, and always stood purse in hand to help others who could do the same. He did not, however, understand Leonardo. Verrocchio did, but if ever, meeting Lorenzo, Verrocchio ventured to recommend Leonardo to him, Lorenzo would retort:

"He lacks polish. Latin or Greek, good Verrocchio. Let him study the classics."

"But, Sire, his talent as a painter is exquisite."

"Perhaps, but he is indolent."

"Not he. His is an ardent mind that would comprehend the universe."

"No artist then. A scholar perhaps."

"My lord, he is neither scholar nor artist. He is a discoverer. He would discover new Truth and Beauty. Not by studying the ancient writers, my lord, but by studying the forms of Nature in his way. He is for ever noting the appearance of the world. This is light, that is dark; this is hard, that is soft. And he asks: Why?"

"Plato, my Verrocchio, tells us that this world is but a copy of another, an ideal world."

"Indeed, Sire? Leonardo's way is to discover this deeper world. He devises cunning experiments by which Nature reveals herself to him. It is a kind of thought process of his, my lord; something which may some day transform the world."

To which Lorenzo de' Medici would reply, "My good man, I detest prophets. We have too many of them in the Church."

Leonardo once showed his friends some pen-and-ink sketches

and a painting of the *Madonna and Child*. Verrocchio gave a swift glance and cried, "Bravo!" The pictures were as real as life. No wooden images these, fit only for candles and incense and sickly piety, but adorably human. The mother, modelled after one of many real mothers in Florence, holds the chubby child in her lap. In the painting the child examines a flower-stalk in his mother's hand. In one sketch the flower is changed to a bowl of fruit into which the child plunges a fat, dimpled hand, while with the other he reaches up to his mother's face. In another, the child clutches an unhappy cat, and above the child the mother smiles. The smile, so full of indulgence, seems to float outward until it embraces all wayward humanity which, like the child preoccupied with flowers and play, reaches up to her for reassurance.

Could Master Uccello with his passion for perspective explain how Leonardo achieved the effect of the smile? Master Uccello might indeed point out that the effect was no accident; that the design of the pictures, so novel and powerful, was conceived by a man who understood the beauty of geometric form.

"Look here," he might have argued, "the design common to all these sketches is in the form of a pyramid. Take the painting: the base of the pyramid is the folds of drapery which undulate across the picture. On the left side the line rises steeply, taking in the contour of the mother's arm and head, and leading to the smiling face. On the right side the line sweeps up over the child's back and again to its apex, the smile. There is an exciting motive in the centre of the triangle, the rhythm of hands twined about the flower-stalk which points upward and again to the smile. Wherever your eye falls it is directed to the smile of the mother."

So might Master Uccello have explained the structure of Leonardo's picture of the *Madonna and Child*. He might have explained the geometry of those landscapes. But no mathematician could tell why Leonardo chose landscapes so twilit and restless, or Madonnas so human and tender. For they were secret forms that rose from the bottom of his soul, phantoms of his experience among the hills and streams of Vinci.

How Leonardo learned his Trade

HE could remember as far back as the cradle and the shock of fright he had once had there. As he lay in his swaddling clothes, a shadow fell upon him, the shadow of a huge bird hovering over him. Its wings came between him and the sun. Its huge forked tail brushed his face and struck him over and over again on the mouth. . . . A dream? He no longer knew, but looking back he made the bird out to be a kite. He was often to ponder the shape of that forked tail which seemed to him an efficient rudder for navigating the sea of air.

Of the bird Leonardo may have dreamed, but the cave was real. Vinci, where he grew up, was a hill-town above the valley of the Arno. He could gaze out over the blue, heaving landscape and see clusters of houses poised on a ledge or clinging to a slope. Vinci must look like that, he thought; but the distant hills were bluish, and in the morning, with the sun behind him, a deep blue. The colour puzzled him. Years later he discovered that hills were not blue. Space was blue, and the more space one looked into, the bluer the world seemed. The changing colours of the scene never escaped the boy's eye. He knew the haze of sunrise and the glow at the edge of the sky. He saw the dark cypresses rimmed with light. He watched the shadows of clouds gliding on the hills. He liked best the diffused light of the late afternoon, which blended and composed the tones of the landscape. That was the hour of day that inspired him to try his hand at a sketch of the distant castle with its belfry, the silver leaves of the olives, the trailing vines, and all the strange patterns of Nature. As he wandered over the hillside, he picked up wondrous samples of Nature's art in snakes and bats and lizards and all the miniature forms to be found on the mossy side of the rocks.

In the course of one excursion he came to the yawning mouth

of a cave. He stopped and looked round him. The angle of the hills was new to him. He crouched on one knee and peered into the deep shadow. He could make out nothing. Cautiously he groped ahead. The shadow became blacker and the air dank. A sharp edge dug into his groping fingers. He wanted to cry out but the air choked him. Then he made out jagged bits of shell lying about. He shivered. "It is cold here," he thought. Suddenly he was struck with fear and would have run away. What checked him was not shame, but curiosity. What things inhabited the cave? What were sea-shells doing on a mountain-top?

He went no farther into the cave that time, and not for thirty years did he answer the question about sea-shells on mountains, but he gave immediate expression to his horror of the cave. It happened that his father came to him with a wooden panel.

"One of the peasants brought this to me," he explained. "He wants to have a picture painted on it, and he asked me to take it to an artist on my next trip to Florence. I said," he added with a smile, "that it was not necessary to go to Florence; we have a good artist right here."

Leonardo took up the challenge. The peasant doubtless looked forward to getting his panel back with the picture of a saint in blue and gold enamel upon it. But young Leonardo, who liked to look out upon the hills modelled by the afternoon light, had never known a saint. He had heard pious legends of the Church, of course. But in them he had felt none of the beauty or the cavernous terror of reality.

When he brought his father the painted panel, Piero da Vinci turned to it with a remark. "Why——?" and then stopped, transfixed by the vision of a monster coming out of a cave. Flames darted from the eyes, poison reeked from the gaping throat, vapours rose from the nostrils. The border was as though on fire.

"By Bacchus!" said the notary. "The wood is now worth its weight in gold." And he promptly sold it for ten ducats.

"For four generations we have been a family of notaries," remarked Piero to his wife, Leonardo's stepmother, "but Leonardo will be an artist. When we move to Florence I shall see my friend Verrocchio about it."

So when he was about sixteen years old Leonardo had come to the city to begin his life among the marvels made by the hand of man: the palaces, the markets, the shops. They were indeed marvellous, though they did not blot out of his mind the hills of Vinci. Smoke in the street reminded him of mist in the valleys; a patch of light on a roof was like sun on an overhanging rock. He would stand dreamily gazing at the stains on a wall, and the blank wall became a screen painted with a landscape of mountains, streams, and valleys so vivid that he could copy the scene. Stained walls, he discovered, were like bells—they chimed with any tone or mood.

Not that he had time to dream over stained walls. Besides his work at Verrocchio's shop he attended classes in science and mathematics. If he was free from both, he went to the Church of San Croce to study the frescoes by Giotto, or those of Masaccio in the Church of Santa Maria del Carmine. He scorned to copy the work of other artists. But in the case of Giotto, Masaccio, and his own teacher Verrocchio he made exceptions, because they drew from Nature. He knew the story of the boy Giotto, who was discovered two hundred years before by the great artist Cimabue. The boy was then herding goats and Cimabue, it was said, saw him drawing them with a stone on the rocks. The goatherd had found the best way to become an artist.

For centuries artists had been making pictures by copying from other pictures; but, standing before Giotto's *Death of St Francis* and the *Raising of Drusiana*, Leonardo was breathless at the lifelike expressions of the people made of line and paint. He spent hours in the dim chapel whose walls Masaccio had adorned with Biblical drama. There were the nude figures of a man and a woman leaving the gates of Paradise, the man bent with grief, the woman wailing, and above them a flaming angel against a grey sky. There was a scene from the life of Christ, and one of Saint Peter baptizing people. Leonardo was charmed by the soft tones: olive-greens, greys, and an occasional flame of orange-red. Most of all he admired the realism. One could almost hear the woman wail, one felt the surprise of Peter at Christ's speech, and shivered with the naked man waiting his turn to be baptized. It was clear that Masaccio had learned his craft by observing real people.

One learned everything that way, thought Leonardo—by observing and doing. That was the right way; the wrong way was to copy from other people or from a book.

One of his acquaintances was old Paolo Toscanelli, who spent fine evenings talking of the stars. Once the old man took a needle and punctured a hole in a piece of parchment. "Put it up to your eye," he said. And Leonardo saw that the stars, viewed through the needle-hole, did not flicker and were no bigger than glowing points.

The old man believed that the earth was a globe in form and urged sea captains to sail for the Indies by a westward course. Absurd, perhaps. But one would never really know until some intrepid sailor tried it. Wonders of Nature came to light only by such trials.

His teacher of mathematics often mentioned machines. He showed that by a studied arrangement of wheels and levers men controlled Nature. For Leonardo it was an unforgettable lesson. He became rather obsessed with it. On seeing Verrocchio grind an edge on his chisel, he designed a machine for the work.

In 1479, when as a result of the Pazzi conspiracy Florence was at war with Naples, Leonardo's designs for machines became more ambitious. The lords of Italy were always struggling among themselves for power. The fighting was done by hired cut-throats and Leonardo gave the spectacle no thought. But he saw the cumbrous cannon being wheeled about. He heard of sieges and scaling-ladders, and he thought how poorly the war machines did their work: cannons that were almost immovable, forts that could not keep the enemy off their walls.

He took a sheet of paper and drew upon it a three-wheeled carriage. He imagined it equipped with supple hinges to steer its way swiftly over the field. But what would have made a soldier drop his jaw was the gun that Leonardo's pencil mounted upon the carriage. It had not one barrel, but a series of barrels. No soldier saw the page in Leonardo's notebook—neither that page nor the one on which he drew an armoured car.

"This," thought Leonardo, "is good to break through the ranks of the enemy. But it must be followed up by infantry."

For months he could think of nothing but war machines, and

as they poured off the end of his pen, time and again he stumbled over the same obstacles: forces and weights and how to calculate them.

"I must try out these things," he thought, "with my own hands. And I must learn more mathematics." It seemed to him that mathematics was the key to all mysteries. The machine, the swing of the stars, the surge of the tides, even the ecstasy of a smile, could all be calculated. "I could even learn to fly. Birds do."

But to the lad of eighteen not how to fly but how to draw was the chief concern. There, too, Nature was his model, and he tried to find lines to express the repose of a hand, the firm column of a leg, the twist of a child's body, the loose folds of flesh in the faces of the aged.

Summer was the best time for quick sketching, when he could saunter through the streets of Florence on the hunt for a striking face or gesture. The courts where the ball game, *pallone*, was played were well worth many visits. Sometimes the apprentices of the shop would come across a peasant whose natural grace of body had not been marred by the wearing of a doublet, and they made the most of his uncorrupted form. The poor fellow who had always longed for a doublet and garters and tight shoes was bewildered to hear these 'arty' people congratulating him on his poverty. They posed him in the nude, bending, crouching, walking, turning, and filled their sketchbooks with every kind of graceful movement.

The young artists noticed that the slowest among them was Leonardo. Long after the others were satisfied with their sketches, Leonardo was still doing his.

"No, this is not right," he would point out. "When the foot is raised, the muscles in the back don't pull. Or do they? Which tendon here contracts? I tell you it is impossible to be a good artist and a poor anatomist."

Leonardo's friends showed no impatience, for they knew that whenever it came to a test of accuracy of hand or judgment he took the prize.

This was one test: first a line was drawn on a wall. Then everybody took a long straw, and, at a distance of about fifty

feet, judged the length of the line and cut the straw accordingly. Then they measured all the straws against the line. The prize went to him whose straw best fitted the line. If the line was very long, they took a foreshortened measure and declared how many times in their judgment the straw would go into the line. Sometimes the test was the simple one of determining who could draw the straightest line freehand. When they laid a taut thread over Leonardo's line, the line and thread were usually one.

The young apprentice of Vinci spent his winter evenings poring over the sketches of the previous summer. Some of the best ones he drew over and over again. To test his memory of them he traced the model sketch on glass or oiled parchment. Then he put the model away and drew the subject from memory. When he laid the tracing over his drawing, the differences stood out. These he corrected.

"I've got to be able to test my work," he thought. "Otherwise how shall I know when I've succeeded?"

That was indeed the question. He showed his work to other artists, of course. He listened carefully to their opinions, which were sometimes very helpful. The trouble was that their viewpoints varied.

"It is beautiful," said the boy Lorenzo, who worshipped him.

"It lacks religious inspiration," said Perugino, who was interested only in sacred art.

"The anatomy is not vivid enough," said Antonio Pollaiuolo, who loved muscles and sinew for their own sake.

"Too sombre," said Botticelli, who was quite sentimental.

"The most skilful handling of light and shade that I have ever seen," said Verrocchio, who had a craftsman's view of everything.

Leonardo wished he could see his work as others saw it. He wanted to look at it with the eyes of a stranger. He put it away for a time, and when it had faded from his mind came back to it. That helped. But he racked his mind for a more positive test. Finally he hit on the use of a mirror. He put both the model and his drawing up to a mirror and found that the reversal of their images took away their familiar look. Since the mirror

and his paper were both flat, moreover, the perspective in the mirror was a test of his own perspective.

The one test for success that never seemed to occur to Leonardo was the test of gold. Verrocchio did a thriving business in many things. Perugino was a successful specialist in the angelic. Botticelli was kept in clover by Lorenzo de' Medici. But Leonardo, already well on in his twenties, often found his purse empty, sometimes quite embarrassingly so. The problems of light and shade, the dissection of bodies, the flight of birds—these were nourishing to the mind alone.

"Go to Milan," his friends advised. "The Duke there is a great lover of art and music. He is attracting scholars and artists from the whole world. They say, besides, he is looking for a sculptor to make an equestrian statue of his father. As musician, sculptor, painter, you would have his patronage."

But Leonardo would not hear of leaving his old friend and master, Andrea del Verrocchio. To no one else in the world did he feel so bound. Of his mother, the peasant girl Caterina, he remembered only her laughing eyes. His stepmother had been kind to him, but in recent years he had seldom seen her or the busy notary, his father. As for his friends, with one he had an hour of fun, with another an hour of schooling. But he could be entirely himself only with Verrocchio. To him he was tied by the bonds of all his interests and aspirations.

It was odd that the Court of Milan should want the sculpture of a horse, for horses just then were another tie between him and Verrocchio. In that year of 1480 the republic of Venice commissioned Verrocchio for an equestrian statue of its great soldier Bartolommeo Colleoni. Verrocchio began to look about for the model of a horse. At the same time Leonardo was about to put some figures of horsemen in a new picture of his.

"What!" exclaimed Verrocchio. "Horses in your Adoration picture! You already have a plan for almost seventy figures of people. And a camel. And architecture. Now horses. By the Virgin, man, never was there such an Adoration!"

CHAPTER FOUR

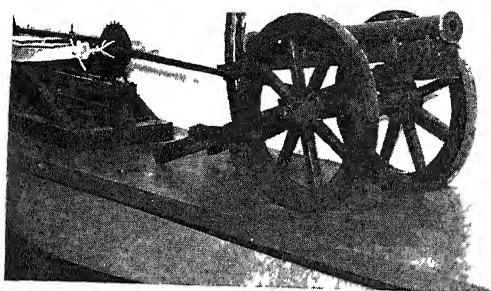
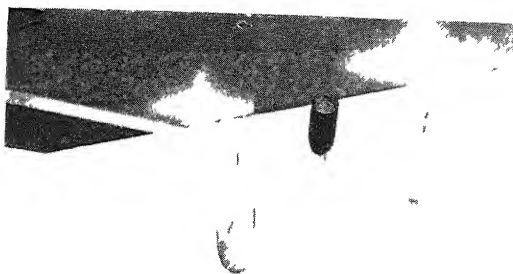
Story of a Picture

I HOPE not," Leonardo agreed. "I hope my Adoration will not be like others. It's no use doing again what's already been done. A new thing needs to be tried."

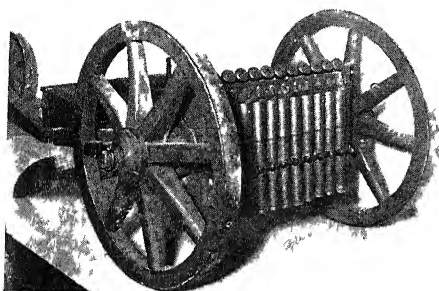
The theme of the Adoration was a popular one. Sandro Botticelli had just finished an Adoration as a thank-offering to the heavenly powers that had saved Lorenzo de' Medici from the daggers of the Pazzi; also as a thank-offering by the artist to Lorenzo for his support. Into the picture he had painted the whole Medici family, and in the right-hand corner his own portrait looked out at one. The light was pleasant, the mood one of simple satisfaction.

Leonardo turned to the Scriptures for the story. Matthew related that:

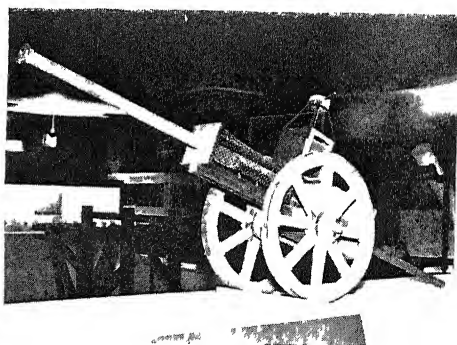
When Jesus was born in Bethlem of Judea in the days of Herod the king, there came wise men from the East to Jerusalem, saying, Where is he that is born King of the Jews? For we have seen his star in the East, and are come to worship him. When Herod the king heard these things he was troubled, and all Jerusalem with him. And when he had gathered all the chief priests and scribes of the people together, he demanded of them where Christ should be born. And they said to him, In Bethlehem of Judea: for so it is written by the prophet. . . . And Herod sent them to Bethlehem, and said, Go and search diligently for the young child, and when you have found him, bring me word again, that I may come and worship him also. When they had heard the king, they departed; and, lo, the star, which they saw in the East, went before them, till it came and stood over where the young child was. When they saw the star, they rejoiced with exceeding great joy. And when they were come into the house, they saw the young child with Mary, his mother, and fell down and worshipped him; and when



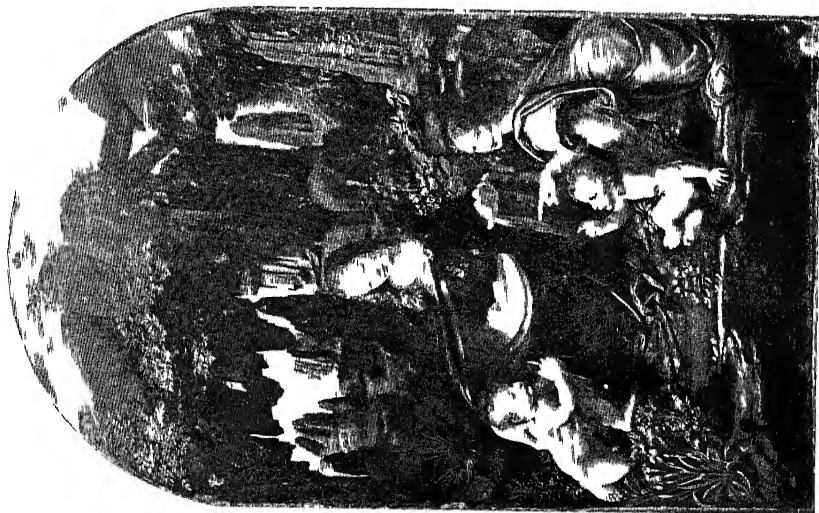
Aerial Bombs and Mortar



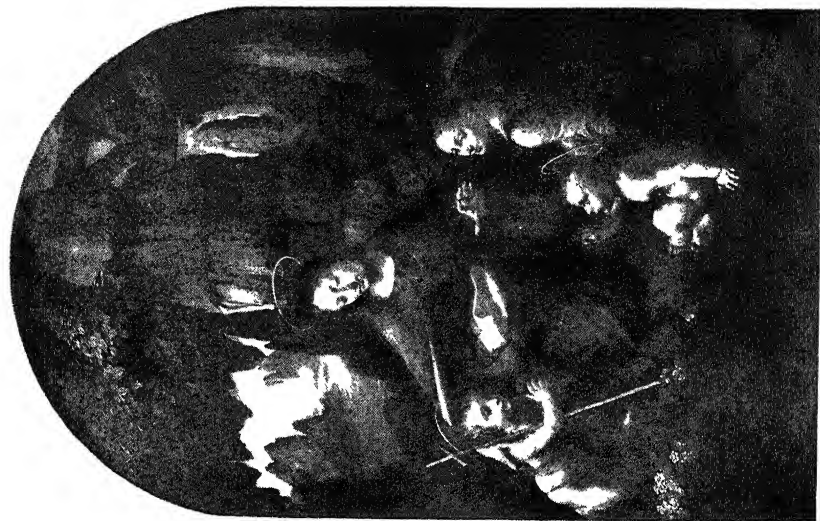
Machine Gun



Steam Gun



London



National Gallery London

TWO VERSIONS OF "THE VIRGIN OF THE ROCKS" (begin 1483)

they had opened their treasures, they presented to him gifts: gold, and frankincense, and myrrh. And being warned of God in a dream that they should not return to Herod, they departed into their own country another way. And when they were departed, behold, the Angel of the Lord appeared to Joseph in a dream, saying, Arise! and take the young child and his mother, and flee into Egypt, and be thou there until I bring thee word; for Herod will seek the young child to destroy him. When he arose, he took the young child and his mother by night, and departed into Egypt. . . .

Botticelli, like other professional artists, saw in this account only the excerpts celebrated by the Church: the guiding star, the joy of the Wise Men, and the humble bringing of gifts. But Leonardo saw also the alarm of Herod at the threat to his power, the agitation of the people of Jerusalem, the conflict of the old and the new. He saw a canvas full of turmoil. He saw it all the more clearly because his own mind was then not at rest.

Verrocchio, it seemed, might have to leave Florence. If the governors of Venice accepted his design for the statue of the horseman Bartolommeo Colleoni, he would have to go to Venice to work on the clay model and then the bronze casting. The thought of parting from his best friend was to Leonardo like seeing the stones of Florence crumble under his feet. Verrocchio gone, Florence was a waste. The prospect of Milan rose before him. But peace was not to be found in Milan. The Duke of Milan had been murdered, the Duchess and her young son had been deposed by his crafty brother Ludovico, and the future course of the State was uncertain.

Leonardo did not view the Adoration as a theme of peace and goodwill.

He went out into the streets of the city. Among the crowds in the market, outside the palace or the Cathedral, he sought models for those people who first heard the tidings in Jerusalem in the days of King Herod, and when he could spot them he made a quick pencilled note of their features. The painter, he felt, had to show not bodies but characters. To do this he had to find the gesture that revealed the character. It was not easy to find. One day he had the luck to come face to face with a patriarch

thoughtfully stroking his beard, and into the notebook he went. Passing a church the next day he was able to capture with his pencil the sad face of a woman that plainly said 'Lord, Thy will be done.' Then for a time no luck, nobody in sight who could have heard the tidings in Jerusalem in the days of King Herod. Where was the man who clapped his hand to his head in consternation? Or he who heard the tidings with indifference? He who pointed with a sneer of unbelief? He who turned up his face in an ecstasy of faith? He who drew his sword to cut down the infidel?

The search for them was long, but one by one he came upon them and fixed them in his sketchbook. They were only a glow in Leonardo's mind at first. But by this inner light he sought them patiently among Nature's profusion, and he found them real. At last he could truthfully express his view of the Adoration which was that old and young, rich and poor, philosopher and fool, soldier and civilian—the tidings touched them all, for a new world had been born.

He set the stage for the drama. The scene was an open space outside the ruins of a palace. The focus of interest was a triangle in the centre composed of Mary with the Infant on her knee, and the worshipping Magi at her feet. He began the lines of perspective at the lower border and directed them to a vanishing-point high up; he wanted depth for his plan. Embracing the triangle he drew an arc along which his characters moved and gesticulated. The highest plane of the picture he reserved for the distant background of the drama, a dim and atmospheric rumour of a conflict on horse and foot: the old order of the world going down in ruins. Now the continuous motion had to be given repose, so above the middle distance Leonardo put two trees and, in either lower corner, two pillars: in the left a philosopher who contemplates the scene, and opposite him a knight in shining armour—the two pillars of the Christian Church.

One day a few of Verrocchio's elegant clients came into the shop. Leonardo had been working for seven solid months on the cartoon of the *Adoration of the Magi*, and its main features were finished. The visitors looked at it. There was a long silence.

Clearly they did not know what to say. Leonardo waited. At last one of them spoke.

"Ah, yes, my dear fellow, yes," he said with a frown. "Quite striking. Very interesting."

"To be sure," chimed another. "But is it not rather sombre? Cicero states, *Non licet*. . . ."

"I do not understand Latin," said Leonardo.

"A great pity."

"We are warned by our classic authorities against crowding too many figures into a picture," remarked the first.

"I do not follow authority," replied Leonardo. "Life itself is my model."

When he was alone he thought, "How puffed up they are with their book-learning! Truth comes to them all wrapped up in bright quotations. What have I to do with such people?"

He had always been contemptuous of their taste. But when Verrocchio announced that he was leaving for Venice, a revulsion against the second-hand atmosphere of Florence gripped Leonardo. He felt alien and alone.

"I, too, am leaving," he said. "At once."

"But where will you go?"

"To Milan."

"And the *Adoration* for the monastery?"

"No matter. Someone else will do it. I have other plans. Ludovico Sforza of Milan is in want of talents like mine. I shall do well there."

From the corner of the *Adoration* into which he had put such shadows of doubt, the knight in shining armour stood out.

"*Addio*."

Leonardo embraced Verrocchio.

CHAPTER FIVE

A Letter

LUDOVICO SFORZA was pleased with himself, quite pleased. He sat in the seat of the Duke of Milan, filling the carved, high-backed chair handsomely, if a little roundly. His dark, fleshy face was clean-shaven, and his hair was arranged to fall just above his eyebrows in front and just above his shoulders at the back. He was not the Duke—he was merely the Regent of Milan—but who would insist on the distinction? The man who pocketed the taxes and hired the army was the Duke, whether lawyers liked it or not, and in the year 1482 that man was Ludovico Sforza.

Il Moro, the people called him. The word meant both ‘mulberry’ and ‘Moor.’ The dark-skinned Ludovico had adopted the mulberry as his personal emblem because, like him, the mulberry was a late bloomer. But he was determined that the slow-ripened blossom of his career should also be lasting. He clenched his stubby fingers round the resolve. Rivals encircled him, but he could count on the people for 600,000 ducats yearly, to build him a court splendid and safe. In the east the dogs of Venice growled every time he took a step into the territory that lay between them. In the west Naples was none too friendly. In the south the Pope’s armies were always on the prowl. Worst threat of all, the King of France had the power to trample over all the Italys. But Ludovico was confident of his skill in diplomacy. A bribe to the French King, an alliance, perhaps through marriage, with the Duke of Naples, and then he might draw the naked sword against his smaller rivals.

His small, bright eyes threw gleams of suspicion towards every quarter but Florence. Lorenzo de’ Medici was his friend, and *Il Moro* admired all things Florentine. At the time of the Pazzi conspiracy *Il Moro* had rushed to Lorenzo. “Is

there anything I can do?" he had asked anxiously. "Count upon me."

It was a gallant gesture and it cost nothing. At that time Ludovico was not yet Regent of Milan and he had nothing to lose, but his liking and admiration for Florence were sincere.

"If ever I rule Milan, I shall bring up from Florence my artists, my poets, my scholars," he decided. They would design him noble palaces, they would paint him portraits, they would carve his ancestors in marble and bronze, they would make his weapons invincible. The world would say: "The Milan of Sforza is beautiful and mighty. The Sforza Palace! The Sforza portraits! The Sforza Court!"

Ludovico's dreaming eye fell upon a letter before him. The writer, an artist from Florence, was offering him some military inventions.

I have plans for a sort of light and very strong bridge [he wrote]. It can easily be carried and used to pursue the enemy or escape from him. I have other bridges, fireproof and assault-proof, easily lifted and placed. For besieging a palace, I know how to deprive it of water, and to build ladders and bridges, and machines for the enterprise. Also, if, by reason of the height or strength of its position, the place cannot be brought down by bombardments, I have plans for destroying any fortress that is not founded upon rock. Again I have plans for a sort of cannon, easy to transport and convenient to handle, which shoots a storm of small stones the smoke of which is terrifying—

Ludovico imagined the Papal army in flight through the Romagna, plunging into rivers or frantically hunting for bridges, while his own generals arrived to toss their "light and very strong" bridge across the watery span—a delicious thought. He imagined the stronghold of, well, perhaps the Duke of Urbino, deprived of water; the parched soldiers faced by his terrific cannon

—the smoke of which is terrifying. And for sea engagements—[Venice! thought Ludovico]—I have plans for ships which are proof against the largest guns. Also I have means of reaching a given spot by secret and silent ways, by caverns and winding passages, even

under a river. Also I can make armoured cars which enter with their artillery the serried ranks of the enemy, and no body of men can withstand them. Behind them the infantry could follow without opposition. . . .

The writer was more artist than soldier, thought Ludovico: his imagination was so powerful.

In time of peace [the letter continued], I can give as satisfactory service as anyone in architecture and the design of buildings both public and private; and in conducting water from one place to another. I can execute sculpture in marble, bronze, or clay, and painting as well as anyone.

I would moreover undertake the bronze horse to the immortal glory and eternal honour of the memory of the prince, your father, and of the illustrious house of Sforza.

Judged by this letter, the man was not lacking in self-confidence. But the monument to Francesco Sforza would require more than self-confidence. Ludovico would have it the greatest monument of its kind. The world should never forget a Sforza. His father Francesco would have a monument as high as his origin had been low. A common soldier, he had risen in the ranks. A general in the pay of Milan, he had won control of the duchy. Like a true son, Ludovico would glorify the family name by a fitting monument to him.

The letter closed with a request for an opportunity to show proof of the writer's ability, and was signed: *Leonardo da Vinci*.

CHAPTER SIX

It can be made

LEONARDO'S letter was so insistent that Ludovico Sforza, if he understood men, must have thought: "This poor fellow is unhappy. He boasts in order to hide his anxiety." That was indeed the case: Leonardo was unhappy. Without money or friends, the stranger in Milan had tried hard to make the Regent want him because he himself wanted the Regent so badly.

He was not exactly homeless. When he arrived in Milan he went directly to a shop something like that of Verrocchio, though not so big or fine, and asked for work. The owners, two half-brothers named de Predis, seeing what Leonardo was, invited him home with them. They would lose nothing by him: the cloth merchants and the Church officials who bought pictures would see to that. So Leonardo went to the de Predis' home and unpacked his few things: his silver lute in the shape of a horse's head, his drawings of Madonnas and sundry angels. He expected to have to wait some time for Ludovico's summons.

In the autumn of 1482 he was depressed with longing for Florence, and, as time passed without word from the court, the ugliness of Milan became disagreeable to him. He disliked its rows of clay houses with tiles the colour of blood, its rooms dark and damp as caves. Out of these the people emerged at daybreak to go to their work of drawing threads of wool and silk over wooden frames, so that Ludovico the Moor, among others, could adorn his bulging bosom with brocade. They forged breastplates, pikes, lances, halberds, and swords, so that Ludovico the Moor, among others, could seize and retain the government of a State. Leonardo shivered in the blasts of a Lombard winter. From the other side of the moat the towers of the Sforza castle frowned down upon him, and no word came from it.

Leonardo wandered restlessly through the streets, taking what solace he could from his pencil. He picked out old women with chins and noses like nutcrackers, old men with sunken mouths and hanging jowls, men with noses that erupted like gargoyles from a church wall, noses with wings outspread as though about to fly off the face, noses that drooped like his own spirits. These specimens he followed until he captured them. During the chase, at least, he forgot that the Court of Milan was ignoring his letter.

At the de Predis' shop both brothers deferred to his judgment. They were good craftsmen, but the Florentine—by Bacchus!—was a great artist. In the spring of 1483 a monastery gave them the job of building a frame for an altar. The frame was to be trimmed with fine gold and elaborately carved with capitals and cornices and pilasters: a frame, in short, like the glory of God. To be sure they wanted a picture in it; it was customary to have a picture in the frame of the altar. They thought of the customary Madonna on a throne with a saint on each side and a hedge of roses for a background.

"Will you paint the picture?" Ambrogio de Predis asked Leonardo.

Leonardo said he would. It was not the summons he was waiting for, but among his drawings he had Madonnas, Infants, and all the trimming for such a picture. It would be all in a day's work.

On a fine day he went out of the gates of the city and sat down on the bank of a stream, one of many that swept down from the Alps. At home in Florence the young men were then walking arm in arm round the public square, singing of love and the sweetness of life. In the art shops the groups still gathered of an afternoon to chat about a problem in perspective or a recipe for the perfect varnish. He missed them all. Perugino, he heard, had been called to Rome by the Pope to decorate a chapel. Verrocchio was in Venice, working on the monument of the horse, leaving young Lorenzo in charge of his shop. Sandro Botticelli was decorating the Medici villa. And he himself was as though in exile, waiting. Waiting for what? Ambrogio de Predis, who sometimes worked at the court, told him about Ludovico.

The fortunes of Ludovico were uncertain from one day to the next. He was not the Duke. He had taken the Regency by fraud. The legal Duke was his nephew Gian Galeazzo, son of Ludovico's eldest brother, Galeazzo Maria Sforza, Duke of Milan.

The first and perhaps the greatest of the Sforzas was a peasant *condottiere* named Muzio Attendolo and nicknamed *Sforza*, 'force,' because of his great physical strength and courage. As a boy he was one day splitting wood out of doors when a company of *condottieri* came riding past and called to him to join them. The boy hesitated for an instant before committing himself to choose between a life of penury as a farmer and a career of excitement and loot—between the ploughshare and the sword. Then he threw his axe into an oak, saying, "If it stays there it is a sign that I shall make my fortune, and I will go with you." The axe stuck in the tree, and the peasant boy mounted a horse and began the Sforzas' rise to power.

Attendolo Sforza's second son, Francesco, was a *condottiere* hired first by Filippo Maria Visconti, Duke of Milan and his father-in-law, against Venice; then by Florence against Milan; and, after Visconti's death, by the Republic of Milan in a further war against Venice. Finally, realizing that it was now or never, Francesco entered Milan on horseback and was acclaimed Duke by the populace.

Francesco was succeeded by his eldest son, Galeazzo Maria Sforza, who was extravagant, vain, and cruel, inheriting some of the worst of the Visconti characteristics. He became the symbol of tyranny to a group of fanatics calling themselves Humanists, three of whom assassinated him as he was about to enter the cathedral during the Christmas celebrations in the year 1476. At that time his son Gian Galeazzo was eight years old and willing to be guided by his uncle Ludovico, who induced him to sign many documents in his own favour and eventually contrived to banish the widowed Duchess Bona. In 1480 the boy was crowned Duke and Ludovico became Regent. Now it was rumoured that he was aspiring to become Duke. . . .

Leonardo stared at the water shimmering over the disc of the sun. . . . They were a violent lot, these Sforzas, though perhaps no more so than other despots in Italy. And it was into

the keeping of this family that he, Leonardo, was hoping to put the fate of all the vast projects with which his brain teemed. He was risking all upon the nod of a usurper, whose own fortunes hung on a spider's thread, threatened with plot and counterplot, overthrow, assassination. As well lay one's life upon the shadows in the water.

He bent his head. Ah, how strange! The disc of the sun in the water seemed suddenly to shrink. He stood up and drew back, his eye fixed on the image. The farther he receded the larger it grew. Again he stepped forward, and again the image shrank, until, as he put his face almost into the water, it seemed no larger than an angel's halo on an altar-piece. At the same moment he saw deep on the bed of the stream the shadow of a cross.

"Illusion," he thought. "Tricks of light. The cross must be a reflexion of a cluster of bubbles."

A small fish darted upward, veered suddenly, and streaked away like lightning through a maze of cloud.

"How do I look to the fish?" he wondered. "From under water things on land must appear out of their true positions. A ray of light is bent when it hits the water as when it hits a glass lens, or the lens in the eye for that matter."

He brooded on it for a space. "That fish," he thought in amazement, "went swifter than a bird. Water is denser than air; fishes are heavier than birds—their wings are smaller. And yet the fish went swifter than a bird."

Again illusion. . . . Nature seemed to be playing a sly joke on her creature Leonardo, like a magician at a country fair, who, enveloped in a red cloak, drives fear into the hearts of the superstitious. "No," thought Leonardo. "Nature is no cheap magician except to the ignorant. To the understanding mind all her ways are clear. The fishes and the birds move by her law, not by her will. He who would understand must first discover her law."

A feeling of exaltation swept over him, as though he had risen from his knees to find his prayer answered. As he bent over the beaming surface his fancy broke free from the trap of disappointment into which ambition had lured him. He forgot the Moor

and his flimsy court. His mind plunged joyously into the mystery of the ever-moving crystal.

He lifted his gaze to the dusky sky. Low in the west a cloud struck into flame. Elsewhere the void was deep blue. The artist Nature was mixing her pigments of night. A bird swam up over him and poised itself motionless upon a column of air. Its body was red-brown, its head greyish white, and its tail deeply forked. Leonardo's pulse quickened to see the bird of his cradle-dream.

For a moment only the kite remained poised, then swept downward in a long diagonal. He watched it fall and mount again and circle among the airy drifts. He observed that it turned by lowering one wing and beating the air with it. It flashed into his mind that a swimmer does the same thing, and he made a note in his book:

A bird makes the same use of its wings and tail as a swimmer does of his arms and legs. If the swimmer wants to turn right he takes shorter strokes with his right than with his left arm.

Then he wrote:

To rise, the bird raises its shoulders and beats the tips of its wings towards itself, creating a pressure of air which raises it like a wedge.

But the kite before him was just then rising without beating its wings. He watched it, and wrote again:

The kite goes in search of currents. When there is no wind stirring, its wings beat rapidly. Then, tired out, it rests by gliding along, gradually dropping. Then up again. And so on. And if there is a wind, the bird mounts it by lowering its tail and raising its shoulders, and is carried aloft without the work of its wings.

"But why," he wondered, "does the wind not overturn the bird when the bird moves without beating its wings? The force of the wind ought then to capsize the bird."

The answer came from the kite. It suddenly lowered its shoulders and plunged safely under the wind.

Then Leonardo's spirit took wing and he wrote:

A bird is a flying machine working according to Nature's law. It can be made artificially.

He thrust the notebook into his pocket and strode away in the direction of the city. He marched to the beat of the words "It can be made artificially."

The city glowed with the spring twilight and the fading tones he liked best. People were sitting in open doorways, their faces emerging from the shadows with an unearthly charm. Leonardo stopped. Why, the new altar-piece! Like a flare in a dark room something lit in his mind, and by the wavering light the design for his picture stood out. The light, distant and unearthly, as though through a cave, as though through fissures in a wall of rock; the Virgin with her back to the rocks; the Infant on the ground before her.

The flare died down and his mind returned to the refrain: "It can be made." Not only the flying machine. All the machines that Nature used in her work could be made. Once one understood wind and water and beams of light one could control them. By the soaring power of his mind, man would be set free to fly. By the controlling power of his mind he could free himself from all that bound him to the earth. The machine born of his spirit would save his body.

On the way home he had glimpses of dark, airless rooms. The people he passed were in rags. He had to be careful to avoid the slop that at times was poured out of a door, and the offal in the streets made the sense of smell a doubtful blessing. Every few years the Black Death swept through the city and piled the streets with corpses. In the castles they used quantities of perfume, and at the first evidence of any pestilence fled from the city; but for the poor—comprising the majority—there was no escape in this world from either hard work or much suffering.

"It can be made." Leonardo was white-hot with the thought. The machine could be made to spin and to weave and to shape iron, to move rivers and mountains and build healthier cities. The machine was the embodiment of man's longing to be free. Only when he knew how to control Nature would he be a free man.

At home Leonardo began the altar-piece. Never had he felt such a sense of peace. The real world with its petty cares vanished. His world now lay between the borders of his canvas. It was blank, and he was to give it life, to bring out and express upon it the thought in his mind. Peace and a sense of power were with him.

Madonna of the Rocks

A CAVE, yes. Surely," said the man in the cowl. "When the holy family fled from the wrath of Herod they took refuge in a cave. So say the Apocryphal Gospels."

Besides the monk, a number of others were appraising the picture *The Virgin of the Rocks*. People often dropped in at the de Predis' shop, and they never hesitated to give their opinions.

"Charming," murmured a gentleman of the court. He was dressed in a flowered-silk garment and wore a heavy gold chain about his neck. His hair had been curled. "Your Madonna, Master Leonardo, is utterly charming. Such innocence."

"By Jupiter!" exclaimed another. "The gods will be jealous of thee for thy *simulacra sancta*."

He was a fashionable poet and took pride in his Latin allusions. In his conversation pictures were *simulacra*, the Lord was Jupiter, and the Roman gods still ruled from Olympus.

Ambrogio de Predis, like an eager student, was measuring the picture with a rule and compasses.

Leonardo stood silently to one side. He liked to listen to shop talk. Usually he worked in solitude, feeling the presence even of a friend a strain upon him. Most comments about his work were also worthless. But he listened for that random remark that would be like the opening of a door to a room of which he was not aware.

"An isosceles triangle, precisely," said de Predis.

Scattered round the finished picture lay sheets of working sketches: the Madonna kneeling to the left, the Madonna kneeling to the right, two tumbling babies. The artist seemed finally to have adopted the idea sketched in the centre of the sheet: the Madonna kneeling, the arms extended over two children, one on either side.

"How humble and trustful seems your Saint John," said the monk—"and how wise the eyes of Jesus!" He hesitated. "But it is most unusual."

"Most delightfully so," declared the courtier.

"Fame herself shall spread abroad thy name with mighty sound of praise," recited the poet.

"The usual altar-pieces show the Madonna on a throne with a saint or prophet standing on either side," the monk went on. "The background, too, is usually gayer." He pointed to the picture. "These rocks and this dark pool seem a bit gloomy."

"I'll tell you," the poet broke in. "The horrendous rocks are a symbol of the perils of this world, the cave a symbol of confusion, the dark pool into whose murky depths—ah—" He stopped, quite confused himself.

"But," the courtier protested, "Master Leonardo has given you an altar-piece quite like the others. The Madonna is the highest figure. She has an angel on one side and a saint on the other."

"But Saint John is an infant."

"Because Jesus is."

From time to time in the discussion they threw glances at Leonardo, as though to say: "You are the artist. Speak and explain, for heaven's sake."

The monk spoke with emotion. "I do not deny its heavenly beauty. Those two hands like halos above the child's head. Our Lady's cloak of protection thrown about John, as it is round all of us, if we but felt it."

"Nonsense, man," said the courtier. "Master Leonardo sings to us the joys of this life. His grass and leaves are Nature's. I myself have known such rocks. And such an angel," he added with a laugh.

"Pray, sir, why does the Angel point to Saint John?" asked the monk, turning to Leonardo.

Leonardo held up a design which seemed a reproduction of the one they had been discussing. The principal difference was that the pointing finger of the angel was missing.

"Which do you prefer?" he asked.

There was a pause. Finally the monk said, "It is amazing. Without the pointing finger the picture loses its magic."

"It is plain," retorted the courtier, "that the finger is out of place. The picture is truly magical without it."

The poet, who had been deep in thought, as though he were digging for rhymes, now began:

"Thou limner of beauty, Apollo's child—"

"Luke is the saint who watches over artists," interrupted the monk tartly.

The poet glared at him.

"Tell us, now," the courtier at last appealed to Leonardo, "which do you yourself prefer?"

Leonardo smiled but said nothing. "You like what you understand," he thought. And he understood both. He understood them because they came from his hand. Let who would talk; he would continue to paint.

"At any rate, Master Leonardo," said the courtier, "I am sent by our master Ludovico to bid you paint a picture of one of our most beautiful ladies in Milan, the lady Cecilia."

The summons had come.



PORTRAIT OF CECILIA GALLERANI (c. 1483)



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STUDY FOR THE SFORZA STEED (c. 1488)

The Girl with the Ermine

SHE could hardly have been over seventeen, or more charming. For hours at a stretch Leonardo kept looking at her. He studied the oval face, set high on its stalk-like neck, and summed her up as still unspoiled and simple. She had the wide eyes of one who listens. Her nose was straight, with eager, fluted nostrils. She was trying hard to keep the ripple of her mouth firm, but in the corners the dimpling shadows betrayed the effort. She seemed about to burst out again with:

“Oh! What a bore! I must rest. May I look now?”

Interruptions came frequently. Often she needed to look to her hair, which she wound under her chin so that it looked like a nun's coif framing her face. Most of the annoyance, however, came from the weasel she held in her arms. The weasel, or ermine, was a problem that tried the patience as well as the brush of Leonardo.

“Down! Be still!” the girl cried, and, waiting for his subject to settle down, the painter contemplated the sleek fur, the serpentine head, the crafty paw. Sometimes a wave of people would suddenly engulf them, Ludovico with his retinue clinging to his silken cloak. Across the little courtyard to the corner of the wall where Leonardo had set up his easel went the assembly of nobles, ladies, ambassadors, and buffoons. And then Leonardo could watch the light of the sun change and mourn the loss of an hour's work while a torrent of inanity broke round him.

“Happy ermine!” Ludovico ventured. “Cecilia, my dear, don't tire yourself.”

“Happy painter, to be made immortal by the beauty of Cecilia.”

“A new Apelles.” The court poet hailed Leonardo with the name of the most celebrated painter of antiquity. The poet

depended for his bread on his stock of fancy epithets. He spoke of his patron, Ludovico, as "Italy's true Messiah," "Greater than Pericles," or "Wiser than Solon." Bernardo Bellincioni prided himself on the variety of his stock. When a courtier's pet—a falcon or a dog—perished, or when a courtier's baby was born, the official poet went over the epithets, chose appropriate ones, and composed them into what he called a poem. So he earned his keep. Even before he had seen Leonardo's picture he had prepared a sonnet in which Nature herself told how envious she was of Leonardo's work because it was so lifelike, or how the beauteous eyes of Cecilia had put the sun in the shade. The poet did not neglect to ensure the sonnet's acceptance by including a compliment to Ludovico.

Almost the first person Leonardo met when he was summoned by Ludovico to paint the picture of the lady Cecilia was this poet. Ludovico had imported him and a certain historian from Florence. Together they were to sprinkle the Court of Milan with the perfume of culture. The poet would celebrate in rhyme the greatness of Ludovico, and the scholar would celebrate it in prose by writing a 'history' of the Sforza family.

"The lady," the poet informed Leonardo, "is the sweetheart of our master."

The painter was practical. "What are Ludovico's emblems?" he asked.

"The mulberry, chiefly."

"No other symbol?"

"A Moor, after his nickname," replied Bellincioni. "And sometimes an ermine—for purity. The ermine would rather die than soil itself. Trapped by hunters it awaits its doom rather than take refuge in a muddy lair. Ludovico sometimes fancies himself just as uncompromisingly pure. A beautiful allegory."

Leonardo made a grateful note of the ermine's character. The painting of a portrait was not to be all drudgery after all. He was attracted by the ermine.

"And wait," cried the little poet. "Does not the lady's surname resemble the Greek for ermine? Gallerani, Gale, Galea. . . ."

"The lady in the portrait shall hold an ermine," said Leonardo.

"A beautiful allegory," declared the poet.

The artist set the animal on the left arm of the girl, with the fingers of her right hand lightly stroking its body. He had asked her to wear a necklace of beads one strand of which drew the eye from her face to the head of the ermine. The body of the ermine insinuated itself into the form of the girl.

Ludovico was enchanted. The ermine on the canvas struck him as put there by a wizard's hand.

"You shall do the steed," he said to Leonardo. "None but the hand that painted my Cecilia shall model the image of the great Francesco Sforza."

He did not appreciate a certain quality in the portrait—which was just as well. For, by Leonardo's brush, the girl and the weasel became one, their faces like two blooms on the same stem of beads, their eyes fixed on the same point, the girl's fingers tapering into the beast's paw. The ratlike head took on something of the beauty of the girl, and the girl took on something of the alert, predatory look of the ermine. But Ludovico saw only the living image of Cecilia. "Now I have two Cecílias," he said.

He turned gaily to the little poet. "What think you, Signor Bellincioni? Is not painting the best of the arts?"

"Indeed, no, my lord," said the poet. "Poetry is that. For the painter cannot tell a story as can the poet. Painting is but dumb poetry."

"How answer you that, Signor Leonardo?" challenged Ludovico.

Leonardo retorted promptly, "Then poetry is blind painting. The poet uses words to suggest images; the painter creates images themselves." He pointed to his portrait of Cecilia. "Which do you prefer, my lord: the lady's beauty described in words, or this painting? As for telling a story, the painter does that more swiftly than the poet. He shows the scene of action."

"Painting is but a manual art," sneered the poet.

Leonardo laughed. "No more than is poetry. Does not the poet use his hand to write?"

Ludovico liked that sort of talk. It gave him the sense of being

master in the affairs of the mind as well as in the affairs of the world. A prince ought to encourage artists and scholars, if only for their practical uses. An artist like Leonardo could design luxurious buildings, he could carve a statue that would make the name of Sforza ring throughout the world. So could the scholar with his story. . . . And all that helped to secure the loyalty of the people. The loyalty of the people had to be secured, if a prince was to prosper. It would secure for him goodwill abroad. And that, too, helped him to prosper. The affairs of state were many and difficult, and Ludovico found recreation in an occasional *duello*, an intellectual duel. It gave him rest from the work of scheming to outwit the French, the Venetians, his nephew the real Duke—in short, everybody else. A good dinner, a few ladies and gentlemen of the court, a scholar, a friar, an artist, and a subject like: *Is poetry the greatest of the arts?* or *What is happiness?* and not only did the evening pass pleasantly, but, as a toadstool was sometimes taken for a mushroom, he acquired the reputation of a humane and learned prince. Ludovico needed such a reputation when his agents stepped across the moat of his castle to collect those six hundred thousand ducats in taxes every year.

Now that he was commissioned for the monument of Francesco Sforza, Leonardo went to consult the historian in the palace.

"Leonardo," exclaimed the scholar, "and what news do you have of Florence? Are you not homesick for the gay chatter round the palace, the boats on the Arno, and the vine-clad hills?"

Leonardo was not. He could ask as did the poet Dante: "Do not the sun and stars shine everywhere?"

"Ah, sir, not the sun and stars of liberty," sighed the scholar. "Do not misunderstand," he said hastily. "There is no lack of freedom here. Ludovico is a humane and learned ruler, like his father Francesco before him. It was Milan that three hundred years ago raised a glorious revolt against tyrants, established a republic with parliament and president, and spread the tameless spirit of liberty across the plains of Lombardy."

He stopped. Again with a sigh he went on: "Alas, the new-born freemen fell to quarrelling among themselves, brother against brother, city against city. Rival banners were raised and the

foolish people rushed to one or another. A man that wore his feather on the right side of his cap became the enemy of him who wore his feather on the left side. One sliced his garlic crosswise, another straight down. One wore white roses, another red. Because Romeo belonged to one faction, Juliet to another, love was slain. The people, bleeding and exhausted, committed the fatal act of weakness: they called upon tyrants for help. And then liberty was slain, and the struggle began over again."

The scholar rubbed his eyes. "That is the agony of Italy, sir. Ah, yes, Francesco Sforza. Tyrants live in fear. They dare not arm their people, and they need protection. So they call in mercenary captains. Of these Francesco Sforza was one of the bravest. He was in the pay of the Duke of Milan. The day that the people overthrew the Duke, Sforza was in the field. That was his chance. Turning, he marched his troops back to Milan. The infant Republic was just learning to crawl when Sforza's cavalry thundered in at the gates and crushed—I mean, to be sure, took custody over—the State. He was proclaimed Duke."

Leonardo took out a sheet of paper and let his pencil wander over it.

"Francesco was a good ruler," the scholar continued. "When he died his eldest son, brother of our master here, took his place." The servant of Ludovico Sforza was silent for a moment. Leonardo raised his pencil. It had left on the paper a trace of the thought running through his mind. He had sketched a horse with its forefeet high in the air, as though about to trample a prostrate foe.

"He was assassinated."

Leonardo looked up. He had once seen Duke Galeazzo Maria Sforza. It was in Florence in 1471. Verrocchio had come into the shop with the news that the Duke of Milan was to visit Florence, and the Medici had ordered from him a few costumes for the occasion. Leonardo had helped to prepare the costumes and then one day stood in the crowd that watched the spectacle of the Duke's entry into the city. Preceding the Duke were fifty horses in cloth-of-gold trappings and a number of carriages drawn by two or four horses draped with silk. He had brought

with him two hundred baggage mules, five hundred dogs of different breeds, forty pipers and taborers, and a flock of hunting hawks. Then came a sickly, overdressed man trying hard to look gallant. It was the Duke. Behind him rode two thousand of his courtiers. Leonardo had heard it said that this piece of vanity had cost the people of Milan two hundred thousand ducats. But vanity was the least of the Duke's failings.

"His Duchess—but enough. And yet, though the Duchess is gone, our master is not safe. She is aunt to the French King. The King is yet a boy, but some day he may lay claim to Milan, a claim based on his aunt and his invincible army."

Leonardo looked again at the sketch, his first stroke in a daring plan to set up a bronze colossus of a prancing horse and rider. He knew of no other equestrian statue in which the horse reared up like that. Even Verrocchio's statue of Colleoni was to be in repose.

"Italy," the scholar mused, almost moaning. "Milan against Venice, Venice against Rome, Florence against Pisa, every province against every other, Italy ripping out its own vitals. Perhaps our master Ludovico will some day rise to such great power that he can save Italy from suicide. Let us hope for peace and freedom."

Leonardo did not reply. He cared nothing for the rivalry of one Italian duke with another. He was subject only to the invisible Prince Who ruled everything under and above the stars, and Whose natural law admitted no rival. At that moment His loyal subject Leonardo had found both peace and freedom: the freedom to choose the design of his monument, and the peace that comes from working it out.

He took leave of the scholar and crossed the courtyard with its clanking men-at-arms. In the shadows of dusk, the towers of the castle frowned and seemed to menace the city beyond the moat. The court and its people were like the portrait of the Girl with the Ermine: beautiful and predatory.

Witches and Dreams

ONE evening in the summer of 1484 Ludovico brought up the fact that at Como, not far from Milan, the people were out witch-hunting. The Pope had issued a bull against witches and at Como alone some forty women had already been put to the stake. Crowds of frightened women were fleeing to other countries, just as, a few years back, the Jews and Moors of Spain had to flee from similar persecution.

"It should be easy for a witch to escape," remarked the court poet. "She can transform herself into a beast. A cat usually."

"Yes, but even that may not help her," said Cecilia. "The people are attacking all cats. Other beasts too. It helps to discover who is and who isn't a witch."

Leonardo shot an inquiring glance at her.

"Suppose you only injure the cat, and she escapes. Why, then, the witch, if she were a witch, bears the mark on her body," she explained.

Leonardo still raised an eyebrow.

"Don't you see? If an old woman has some deformity, or mark on her body, why, I mean she was a witch who had changed into a cat. Don't you see?"

"No," replied Leonardo.

"Listen," explained Cecilia earnestly. "I was told about a wolf that attacked a carpenter in a forest. With his axe the carpenter struck off the foot of the wolf and drove him howling away. The next day one of his neighbours was seen with only one foot, and he confessed to being a werewolf."

The Duke turned to his astrologer, and the topic broadened to include the mysterious ways of sorcerers and demons. "Creatures of conscience," thought Leonardo. "And powerful only if we believe in them."

"An abbot near by," said the astrologer slowly and heavily, "avers that the air is as laden with demons as with dust. They appear as large cats, bears, or lovely women. The abbot declares that once as he was climbing a lonely road of a mountain he heard the spirit of the mountain calling to the spirit of the lake at its foot. 'Beware of a mortal in our midst,' said the voice. 'We can do nothing,' was the spirit's reply. 'He has made the sign of the cross.'"

A dispute arose as to what language spirits spoke and Cecilia asked Leonardo his opinion.

"They speak no language," said Leonardo. "They cannot speak and for two reasons."

"Give us one," demanded the astrologer.

"Spirits are incorporeal, without a body."

"True."

Back in Florence, at the hospital of Santa Maria Nuova, Leonardo had carefully noted the air-sacs in the human lungs, as well as the wind-pipe and the voice-box.

"There can be no sound," he pointed out, "without proper motion of the air. And the air cannot be set in motion without some instrument. Having no body, spirits have no speech."

There was a silence full of doubt. "And the other reason?"

"The other reason why they have no speech," Leonardo continued, "is that they have no existence."

"Nonsense," said the astrologer.

"Well, what does a spirit look like?"

The astrologer tossed his head in derision. "A spirit does not look like anything. It has no substance."

"Then," said Leonardo, "a spirit would be a vacuum in the air about it, and the air rushing into it would destroy it."

No one liked to have a hard mathematical proof rob him of his thrilling beliefs, and a protest arose that Leonardo was without faith, a heretic.

"One witch, a young wench," remarked the astrologer, "before her death confessed to her practice of witchcraft. She had sold her soul to the devil, and as she perished in the flames some said they could hear the beat of wings when the imps of hell carried it off."

Speaking of the black arts, the poet told of reading about some students who, like Leonardo, had doubted the powers of a certain necromancer, and called upon him for proof.

" 'You shall see with your own eyes,' said the magician, whereupon he traced a circle round them with his sword. Then he uttered his incantation and *psst!* a group of demons disguised as soldiers appeared on the fringe of the circle. 'Come,' urged the demons. 'Come with us and we shall make soldiers of you.' But the students had been warned not to step out of the magic circle. The soldiers vanished and in their places appeared a bevy of dancing girls. One of them held out a ring and a foolish student snatched at it. Poof! he was gone."

"Poor child," said one of the ladies with a deep sigh.

"Oh, the necromancer was able to save him from his folly. He called upon the chief of the demons. He pleaded his faithful service and suddenly poof! the lad was back in the circle, pale and half dead. When his friends asked him where he had been he could utter only one shaking word: 'Hell!'"

"What a fool that magician is!" said Leonardo. "Why doesn't he take over the world? With such devilish accomplices he should have no trouble in possessing all the gold and destroying whom he would with his bolts of lightning. Instead, he depends for his bread on his fees and the goodwill of his clients."

But it was no use. They fell to talking of omens and of ways of foretelling the future! A dog howling in the night was an omen of death, as were phantom horsemen. Even a sneeze was a warning from the world of spirits. A comet portended the death of a prince—God's gesture of respect. To meet a priest in the forenoon was unlucky. And never, never should one begin a journey on a Monday. . . .

"Even Master Leonardo," someone said, "believes in augury. He himself watches birds."

"What nonsense!" cried the astrologer. "What unscientific nonsense."

Only an astrologer could interpret the will of fate. At least so said the astrologer. Like a priest in Babylon he knew that the moving stars wrote their message to mortal men upon the scroll of the sky. Any man who wanted to know when to

undertake a journey, a business deal, a doctor's treatment, or even to take a wife, saw his astrologer. The universities taught astrology as a science, and princes like Ludovico all had their official astrologers.

"I remind your lordship," said the astrologer, "that when the plague broke out in Milan in 1402, a comet swept across the sky. The then Duke, pointing to it, said: 'My hour has come.' He died soon after."

"I cannot see the logic there," said Leonardo. He did not like astrologers. Of all the frauds, they were perhaps the worst who masked themselves in the dignified robes of science. He did not mind alchemists; their ways at least were scientific. If they held out to Ludovico the promise of making gold out of base metals, the more fool he to believe them, and the more rogue to need so much gold. But the astrologer who prescribed for a sick man a brew made of scorpions caught when the Dog Star Sirius was in conjunction with the sun—that man was a danger.

"Do you not believe in miracles, Leonardo?" asked Ludovico slyly. Cecilia told how a friend of hers once prayed before a statue of the Virgin to help her to win the love of a knight. Sure enough the eyes of the statue moved and the mouth smiled and the next day the knight declared his love.

Miracles! thought Leonardo with contempt. God, to these people, was a street mountebank with a bag full of tricks. "Yes, I believe in miracles!" he said passionately. "Is it not a miracle, my lord, that these walls obey the mathematical law of the architect who made them? We sit here trusting that they will not topple down upon us. Is it not a miracle that when the sunlight falls upon the water in the moat yonder it is reflected at an angle equal to the angle of its fall? To-day, to-morrow, and for ever will it happen, wherever the sun shines upon water. We can predict it, and rely upon it; it will not betray us. Of such miracles my heart is full."

The Duke coughed and the courtiers stirred uncomfortably. There was no answer to Leonardo. But a *duello* was only a *duello*. The ladies of the court would still hang charms round their necks to ward off the evil eye. They would still light the witch's stake under some old peasant woman. They preferred

the thrill of the theatre to the athletic faith of Leonardo and at the next outbreak of the plague Ludovico, like the Duke of Milan before him, would run from the wrath of heaven and send for his astrologer.

This did indeed happen when, late in 1484, Ludovico's agents brought him the dread news that the city was again in the grip of an epidemic. The ladies and gentlemen of the court fled to some quiet country seat where they whiled away the tedium by hunting, eating, and dancing; but the people of Milan, without means of retreat, stayed and looked into one another's faces. Often they detected a flushed skin, a swollen eye, an uncertain step. They fell upon their knees and prayed to be forgiven. They applied their unguents and their ritual of magic. And they sought a decent burial for their fifty thousand dead.

Leonardo roamed the city, full of its mortal stench and heart-break. In sight of man's helplessness under the hammer of the Black Death, did not his triumphant hope of wings seem like a child's preoccupation with a toy? But he wasted no time in lamentation.

Plagues breed in filth and spread in crowded quarters, he reasoned: in alleyways and in airless rooms. Plagues can therefore be prevented.

He sat down to address Ludovico on the subject of model cities, ten of which he offered to build. He outlined the plan architecturally. But, beneath the pattern of bare lines, the human picture was clear. His city rose upon the shore of a sea or river where flowing water would ensure comfort and cleanliness. A system of canals irrigated the fields and connected one city with another. Behind the garden of every house a storage tank was installed to deliver water through underground pipes to all parts of the house, for bathing and drainage. Water and wind were natural forces that man had only begun to utilize. He could imagine a windmill with sails built so that on a hot day it sent a cool breeze through the garden. He could imagine the windmill geared to do household chores. He could even imagine it geared to play a musical instrument—a fascinating thought. He took a fresh sheet of paper. What sort of musical instrument could be made to play mechanically? Before the thought left

him he had designed a hurdy-gurdy, and a fiddle played by cog-wheels and springs.

But that was really distinct from his plan of the model city to which he now returned. It must not be a vast metropolis in which the evil of overcrowding would develop. Five thousand houses and thirty thousand people were to him the ideal numbers for one city. He carried his figures a few steps farther and realized that he was running into an appalling total: fifty thousand houses in ten cities alone. For a happier Italy millions of houses would have to be built, and for a happier world how many! His plan would fail if for no other reason than the cost of the labour. Should he put down his pencil, tear up his paper, and stop daydreaming?

His thought took an odd turn: If this house, so comfortable and clean, would do for one happy family, it would do for fifty thousand. Fifty thousand houses alike in all their parts: here was the answer to the problem of labour cost. A single factory would turn out the standard parts and ship them to the site, where they would be fitted together. An odd idea perhaps, but surely a practical one. It had the advantage, moreover, of ensuring a proper amount of light and air for the people, because the houses were all to be the same in height. He laid down the rule that the width of the streets should equal the height of the houses.

His city would have beauty as well as utility. Public gardens, singing fountains, of course. The notion struck him that houses on opposite sides of a road ought to have their rear entrances facing each other, so that deliveries of provisions could be made away from the living quarters of either side. But the ugliness of cities lay in their jumble of roads and traffic. If one went for a stroll one had to use the same streets through which carts of provisions rattled and the city did its daily grind. The confusion was both inefficient and unpleasant. The social pleasures and the business chores should be kept separate, as one keeps separate the kitchen and the living-room of the house, or the garden and the cellar.

The cellar suggested a daring idea: two roads, one above the other; two levels of traffic, the upper for leisure and the lower

for work. Openings in the upper roadway provided the light for the lower, and spiral stairways at intervals connected the two levels.

“What will the Duke say to these plans?” he wondered as he gathered up his papers. Would the Duke see that his people did not have to live plague-ridden, hungry, and toil-worn? Would he help to make the lives of his people full of beauty and health? It was only a question of using Nature’s substance intelligently.

As he went towards the castle Leonardo could only hope.

Ludovico's Answer

LUDOVICO laughed shortly. The artist impressed him as a strange fellow. He did not believe in witchcraft, yet he had visions more airy than those of a conjurer. Ten model cities! A happier realm! Ludovico's jewelled hand played with the chain that hung down over his bosom. A happier rule was all he asked.

The artist, he thought, gave too loose a rein to his fancy. The Sforza horse was an instance of what a patron of the arts had to put up with. Five years had already gone by since Leonardo undertook the work, and in all that time nothing, except a small plaster model, had come of it. Even more exasperating, the artist kept asking for two hundred thousand pounds of bronze for the casting—which could just then be better invested in cannon.

Ludovico walked about restlessly. There again, he thought, Leonardo was an impractical dreamer with his fables of armoured cars, armour-plated ships, and rapid-firing guns. He was an excellent architect, but if one asked him to make plans for the remodelling of an old fortification, he was sure to come back with some wild scheme or other which he claimed would make the place impregnable.

Ludovico himself had taken other steps to fortify his realm. He did not put his trust in stone walls. He knew a better safeguard: a wife—two wives rather, one for the young Duke, Gian Galeazzo, and one for himself. For the girls were not wives alone—they were also military alliances. When the reception was held for the marriage of Isabella of Aragon with Duke Gian Galeazzo at the beginning of 1489, the castle was decked out as triumphantly as after a victory. For Ludovico might have had to meet Isabella's father, the Duke of Calabria, on the field of

battle. By marrying his daughter to Gian Galeazzo, he embraced him in the banquet hall and turned a possible defeat into a decisive victory.

Ludovico rubbed his chin, perplexed. He could not call Leonardo an impractical dreamer after the festivities. For if the reception was famous in the annals of court entertainment, if the news of it had travelled through all Europe, it was thanks to Leonardo and the weird glamour of his spectacle. Ludovico could never forget that night with its wizardry. The girl Cecilia had looked lovely in a gown of ruby red. His heart swelled at the sight of her. To what could he compare her? A tight rosebud, a shapely crystal brim-full of Burgundy, a mulberry swaying on a hillside? She had a coil of pearls round her throat, and he could not keep his eyes off it.

At about midnight came the spectacle which distracted Ludovico's attention from Cecilia. In front of a curtain stretched across one end of the ballroom there appeared a child in the costume of an angel.

"Ladies and gentlemen," said the little angel, "greetings! You are now to have sight of something never before shown—Paradise itself."

The curtain parted, disclosing a huge gilt dome sprinkled with stars. Above the horizon the signs of the Zodiac were drawn in points of light, and in a row of niches sat the planets. Upon this setting moved dancers costumed as Jove and his Olympian gods. Behind the dancers the stars glimmered. Suddenly hidden choirs of music burst into song and, wondrous to behold, the planets began to turn and dance in their orbits. The audience was ecstatic, but when they crowded round Leonardo, the amazing man waved aside their applause with a cold remark about gears.

Ludovico sniffed. "There you have it," he reflected. To Leonardo nothing was sacred, no mystery safe. Everything had its 'gears.' Had someone pointed even to the miracle called Cecilia, Leonardo would probably have spoken of the dyer's vat that gave her costume its charm, the oyster's pearly disease that adorned her throat, and the weakness of a man that made his heart swell at the sight of her.

Besides staging court entertainments and designing costumes

for masked balls and jousts, Leonardo had other duties. He helped to decorate the castle and make it comfortable. He delighted the Duchess by installing a plumbing-system so that she could take a hot bath, and he even built for her a light, portable bath-tub for travelling. Most ladies used heavy perfumes instead of bath-tubs, but Leonardo spared the Duchess that necessity. The only trouble was that when the plumbing went wrong she set up a hue-and-cry for Leonardo—and he was frequently not to be found.

Ludovico had given him a studio on the top floor of the old castle. There one might find him among the few pupils he had gathered round him, young students of art who adored him. At times one would see Leonardo's curly, massive head and silken beard as he directed labourers about the castle. But often the Duchess's men would dash all over the city for days without finding him. Where had he been? He spoke of the hills round Lake Como, of the firs and larches on craggy heights, of the home of the wild goat and chamois, of trapping bears in the snow, of the hardy peasants who had accompanied him.

"I have been where now fly flocks of birds, and where once swam shoals of fishes," he said.

He often spoke in that dark fashion. Once, when with some men of the court he was exploring the hills of Lombardy, he unearthed the skeleton of a huge fish.

"What power was in those fins?" he was heard to murmur. "How many times did the dolphins and tunny fish flee this lashing tail? But the law of nature is stronger," he added in an ecstasy of sadness, "and all must obey."

Ludovico wondered whether it were true that Leonardo was a heretic. What else would you call a man who believed that the earth was ever-changing in form, that the mountain-tops had once been the bottom of the sea, and how could you otherwise explain his dark saying: "The sun does not move?"

When one climbed to the top floor of the old castle to Leonardo's studio, one saw nothing unusual in the queer collection of things that crowded the spacious stone chamber. There was an impression of disorder: here a tub of water, there a lump of copper or a ball of glass. On a long table lay a pile of wooden

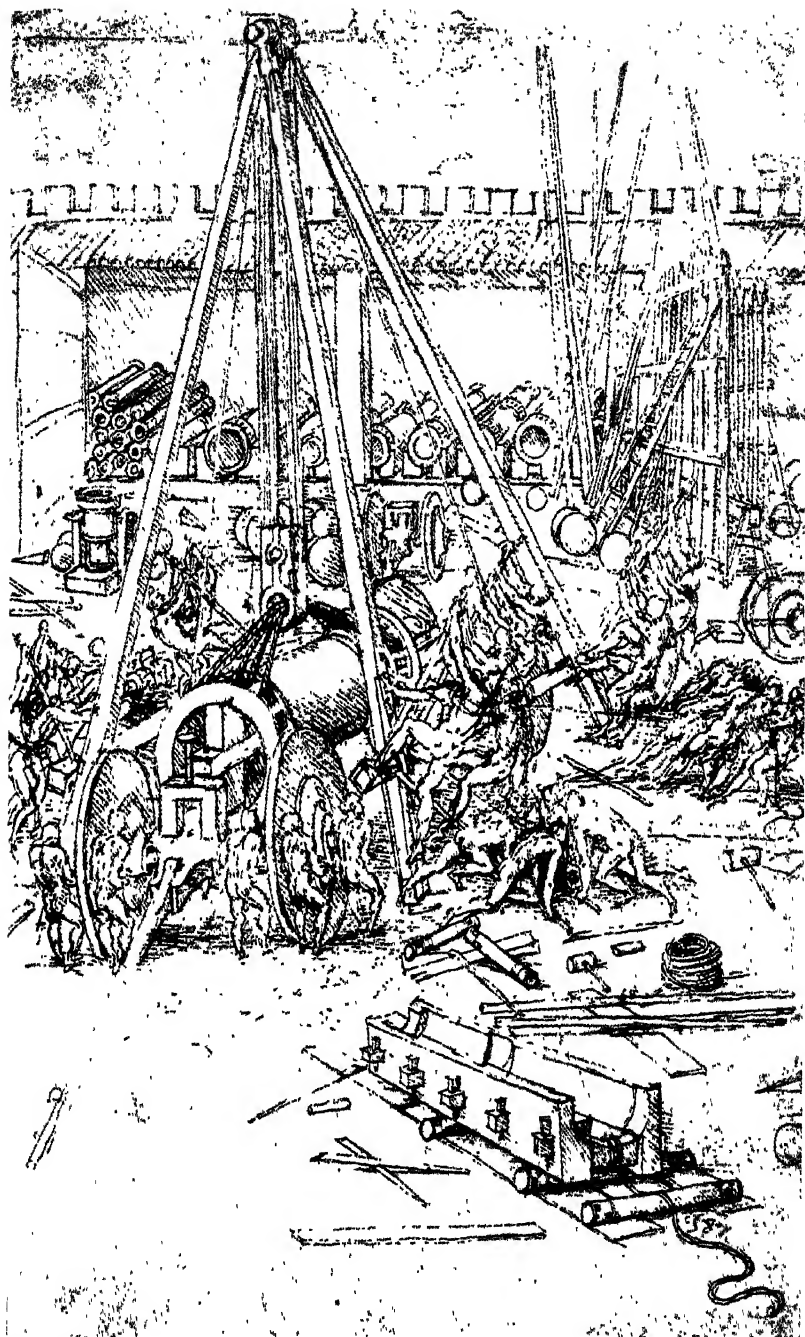


Photo by Braun

COURTYARD OF A GUN FOUNDRY (c. 1487)

slats, some cords, and iron weights. The room was in polar contrast to the astrologer's sanctum or the alchemist's shop with its air of mystery. Leonardo worked with everyday materials. He himself moved among his students, well groomed in a short velvet coat.

"Your drawing is good, Marco. But consider, lad: If you are looking down on two parallel straight lines, you'll never see them meet in a point as you have made them do. . . . Jack, you little imp"—this to a small boy—"don't touch that. You'll upset it. There's a good boy. To-morrow I'll buy you a nice hat with a feather in it."

A courtier who had gone to Leonardo for a design of a coat of arms told of finding him with a doctor from Imola. The two were talking about the sun.

"No, Master," the doctor was saying, "I cannot hold with you. The sun is by no means a hot body as you say. It only gives out a strong light and, naturally, the stronger the light the hotter. But it gives no heat as such. My authority, I assure you, is classic. If you had a volume of Pliny we could find it stated there."

Leonardo held that the sun was a source of heat apart from its light.

"But what is your authority?" insisted the doctor.

The artist smiled. He went to a long table at one end of the room and turned a friction wheel sitting upon it. A shower of sparks fell from the wheel and into this he thrust a torch. When the torch burst into flame he fired some tinder in a brazier that stood on the floor, and dropped a lump of copper into it. He left the copper in the burning brazier, and put upon the table a mirror which he turned this way and that until the angle and position suited him.

"Surely," thought the courtier, "he is not trying to reveal the mystery of sunshine with a few sticks and a glass."

The room was flooded with a radiance shed by a lamp that hung from the ceiling. That was one of the oddest things about the room—its brilliant and steady light. No one else in Milan had ever seen or possessed such a lamp. Yet it was only the usual kind of lamp placed in a glass globe full of clear water.

"The rays of light," explained Leonardo, as he detached it, "pass through the water and are magnified." He measured off a spot on the table and set down the lamp. Strangest of all, he brought out a large square of leather into which he cut a hole. The doctor looked a bit bewildered.

"Now," Leonardo said, "here is my authority." Over the lamp he hung the leather square so that the light shone only through the hole. "The mirror over there reflects not only light but heat as well, does it not? Since it is itself cold, we shall be able through its power of reflexion to compare the heat thrown by the dark copper with that of the brilliant light of the lamp. You notice that I have made the copper equal in size to the lamp. Let us also put it the same distance away from the mirror."

With his tongs he picked up the lump of copper and laid it where the mirror caught the red glow.

"Of course," he added, "to be exact we should make a temperature gauge. But perhaps the feel of the hand will be good enough to settle the question. Put your hand out, Doctor. Those are the rays of hot copper coming out of the cold mirror. Now put your hand out again. That's the lamp."

The doctor looked doubtful. "The reflected rays from the copper are much hotter," he admitted. "But what does it prove?"

"Simply that the heat and the light of the sun are two different things."

"The doctor was still doubtful," said the courtier who told the story to Ludovico. "But, my lord, he did not know what to say. He was like an old wrestler who comes to the mat expert in the ancient art of twisting the shins and neck, and finds his opponent is without shin or neck, but a winged creature who attacks him from the air. They talked of the sea. Again the doctor referred to the noble Pliny; and again Master Leonardo countered not from books but with an experiment. He filled two tubs, one with fresh, the other with salt, water. Into each of them he suspended one end of a strip of dry cloth. 'The cloth sucks up the water,' he said. 'If the fresh is lighter than the salt water, it will rise higher on its strip.' My lord, you would

not believe it, but he took Pliny's truth about the domain of Neptune to hang on the question of how much of the strips of cloth became wet. An experiment, he called it, saying that there is no truth without experiment. As to that I do not know. I am no philosopher. If Leonardo is one, he also has the shrewdness of a peasant who has learned how to grapple bare-handed with Nature.

"He talked with the eloquence of a poet. His thought played among the stars, the winds, and the seas, and all the unseen powers, like that of a pagan priest. Only he does not worship them; he reveals them and takes them in his hand and moulds them like plaster for the horse, or pigment for the portrait of Cecilia. You remember how he startled us the other evening at the *duello*, when he spoke of the laws that govern our universe. Miracles, he called them, because in all eternity they would never betray us. I confess that the majesty of his words moved me deeply. His eyes, I thought, shone with the fire of true faith, though perhaps not our faith, my lord. His revelations came through simple, homely things: a piece of string, a wooden board, a lump of iron. I asked him about an iron box in which lay a sort of wine-skin. He said that it helped him to measure steam pressure, with which he was experimenting. Steam, my lord! I took it to be useful only in a bath, but it seems that Leonardo has other views of it. He measures off some water. He pours it into the skin. He caps the skin with a lid. Upon the lid he puts weights. Then he heats the box, and as the steam expands it pushes the weights up. He measures how far.

"I must mention the queerest of all the contraptions he possesses, one so huge that it takes up a third of the room. Not that it is made of anything but cords and canvas and iron rods. But it is fashioned strangely, like an enormous bat without a head. With it, they say, he means to fly."

"How!" exclaimed Ludovico. "That old, foolish dream."

"Precisely what I said, my lord. To which Leonardo replied that a bird is only an instrument working according to mathematical law. He has a good deal of the dreamer in him."

A bit of the idler, too, thought Ludovico. One day he hap-

pened to look out of his window, and there below was Leonardo—artist, engineer, musician, what-not—and what was he doing in the courtyard of the castle? He was solemnly bouncing a ball on the pavement. The statue of the horse was at a standstill, Isabella d'Este, Duchess of Mantua, was pleading for a picture, while he bounced a ball up and down. Again and again he picked up the ball, let it fall from his hand, and watched its up-and-down course as intently as one might a portent from heaven. When the impulse of the ball died out he drew his notebook from his belt and wrote about it. Odd, to say the least. Some said that Leonardo's experiments were only another name for the black arts; that he grew gourds without roots, that he had injected a poison into the sap of an apple tree whose fruit became deadly; that he bought the bodies of men hanged by the law and in the dead of night dissected them.

One lost sight of him for days. The plaster for the model of the horse was unmixed; a lady of the court waited for her portrait; the Duchess for a costume for her next ball.

"Ah," they said, "he has shut himself up with his sublime thoughts; some deep problem, the moon, the sun, God."

And then it turned out that he had spent the day on some peasant's farm talking, perchance, of eggs: their size, their shape, their colour—or of how to breed fowls.

Ludovico frowned at the architectural designs before him. He summoned his secretary. "Send for Master Leonardo," he said. "Consult him about the cupola for the cathedral and about the new palace at Vigevano. But first send him to Pavia to re-decorate the castle there. And to make sure the work is done, send another architect with him. Send two others. Oh, and the Duchess of Mantua has written to us repeatedly to use our influence with him for a picture. And the abbot of the Church of Santa Maria delle Grazie has in mind a painting of the Last Supper for his refectory. And don't forget to remind him again about the steed," he added wearily. "Curse his scientific rubbish! By the way, tell him to devise a system of irrigation for our rice fields. And on that head, ask him what he would do to make the river Martesana wholly navigable. Very well. Hold on! Have we covered everything? There is, to be sure, the matter

of my own portrait. But that will have to wait till Beatrice comes. And even then, if we have to depend on Leonardo, it will never be done. Experiments? Science? Rubbish!"

He looked out into the courtyard bright with spring. The duchy had never been more prosperous. The world under its heaven was at its best. Nothing broke the round of hunting, feasting, flirting, and intriguing that made up life at court. It is true that the brow of Ludovico grew furrowed at the thought of the young duke Gian Galeazzo, but the furrows faded when he thought of the Duke's ill health. "Poor child," he murmured. It is true that upon the table of state a shadow sometimes fell in the shape of the King of France, who might enforce his claim to the duchy of Milan, but again the sun shone when Ludovico contemplated his alliance through marriage with the King of Naples.

He summoned his astrologer. "The moment is not yet arrived, my lord," reported the astrologer. "When Mars, Jupiter, and Saturn are in conjunction under the sign of Aquarius, then, my lord, will be the most propitious moment for your marriage."

He summoned his physician, who reported: "The brew will soon be ready, my lord. It is made of scorpions caught when the sun is in conjunction with the dog-star. For the disorder you speak of, there is no better remedy known."

He summoned his alchemist: "My lord," reported the alchemist, "we have almost reached the end of our quest. But a little while more. Last night there was the gleam of gold in my crucible. It vanished, I regret to inform your lordship. But if I could have your patience and a thousand ducats with which to continue the search. . . ."

His secretary came back: "My lord, we found Master Leonardo on the banks of the canal. He was throwing stones into the water."

Ludovico brought his fist down on the table. "Stop all payments to him. Let him have no more money until he quits his idling."

"We have already done that, my lord. He was very angry and has not returned to the court since."

Ludovico stared. "He is often seen at the canal," ventured the secretary. "They say his nature has a strange affinity for water. He throws stones into the canal to watch the circles form and die. I have heard that he also tosses handfuls of sawdust into it to track the speed of the current and the play of the waves. He also launches pasteboards cut in different shapes, and studies their movement in the water. He has even laid down a sheet of glass on the bed of the canal so that he can observe the action of the current minutely."

Once, at a *duello*, Leonardo had spoken of the cosmic power of water; how it had moulded the face of the earth from the beginning of time and would mould it to the end. He made people shiver with his icy views of the millennia of time; but Ludovico did not mind anyone's philosophy. So long as Leonardo supplied him with plans to prevent floods, to drain marshes and to irrigate fields, Ludovico did not mind how much sawdust he threw into the canal. Only sometimes Leonardo's plans had a wilder sweep than the primeval torrents. Yes, his nature had an affinity for water; he, too, wanted to mould the face of the earth.

"No, my Leonardo," Ludovico murmured. "We do not care to change the face of the earth. We do not care to build model cities. We are modest rulers. We want you only to finish the horse and to paint a few pictures. And the Duchess is very anxious that you should decorate her palace at Pavia. Otherwise you get no more money."

CHAPTER ELEVEN

Secret Nights

BUT money or no money, Leonardo had no thought to spare for the Prince and his horse, or for the comfort of the Duchess. Ludovico waxed angry; Isabella tapped impatiently with her foot; Leonardo's housekeeper worried about paying the provisioner. Leonardo himself was off on one of his private excursions. He had abandoned the palace, the studio, and the canal banks. His new haunt was the hospital.

It began with an argument over a bone. His friend Andrea, the doctor from Imola, had said to him with an air of triumph: "No, my dear Leonardo, Galen writes that the human body contains thirty vertebrae, not thirty-one as you seem to think. There, see for yourself. Here is the book. Thirty he states, as plain as my nose."

Leonardo laughed. Andrea had proved not that there were thirty vertebrae in the human body, but only that it was so written in the book. And books were words on paper, not the truth of Nature. A man named Gutenberg, up in Mainz, Germany, had invented movable type and a printing press, and many fine old Greek and Roman manuscripts were being published. Leonardo was happy to be able to consult the works of Archimedes or Aristotle or Galen, but there was much in books that he knew to be false. Gutenberg, for instance, had printed for doctors a calendar of days when they should bleed their patients. He had printed a chart of the human body marking with the names of planets the parts believed to be governed by the planets. If one had a pain in the neck and went to the doctor, he turned to his astrological chart. If the chart showed that the neck was governed by Mars and Mars was not in the visible heavens that season, the doctor dare not treat the pain.

Leonardo choked with laughter when he had a look at the

illustrations in Andrea's book on anatomy. Was that drawing supposed to represent the human figure, or a barrel with a child's version of a head set on top? The organs disclosed looked more like idle scribbling. The incomparable artist had moreover ignored the fact that the body had muscles, tendons, veins. And from this woeful illustration doctors were expected to learn anatomy. Leonardo, who insisted, even from his youngest apprentice, upon scrupulous accuracy in drawing, could only shake his head in pity for all sufferers who relied upon doctors.

"Yes," he agreed, "the book says thirty. But I have counted thirty-one."

This vertebral bone of contention was not important. The important thing was that men seemed content to know more about the moon than about their own bodies. What was this machine that Nature had given to man? How did the parts work? Andrea might be satisfied with a book, but not Leonardo.

So began his nightly vigil at the mortuary of the hospital. The secret hours of night were safest for the purpose. He resented having to steal into the hospital like a conspirator instead of what he was, a searcher for the truth to make men free, but from olden times there persisted a tabu against mutilating the human corpse. Even Andrea shuddered.

"Those ghastly bodies. The clammy flesh. The flayed bones. You, Leonardo, have you no fear? Does not your gorge rise? You live in the world of a nightmare."

But, to Leonardo, more fearful than the specimen under the torchlight were the gibbering shades of ignorance. Those at last were clearing up under his knife. When he laid bare the parts of the unknown machine of the body, down to the red pulp of its marrow, his first step was to make accurate sketches.

"Words! Words!" he exclaimed to Andrea. "That is your trouble. Words are inexact. Only lines are true. Only good artists can be good anatomists."

Drawings of pink, fibrous flesh, of shiny layers of gristle, and of stringy white nerves added their bulk to his notebook. Accurate description was his first care. All else in science followed from that. He cut and sawed into a strange world of arches, of pits and canals and waters, all of which he charted painstakingly.

An old friend of his boyhood, Paolo Toscanelli, had made maps to guide sea captains to Genoa. "If you follow them," he had urged, "you will reach the Indies by a westward course. And who knows what new lands besides." Leonardo's drawings, like those maps, were guides to an unexplored world.

He showed Andrea an exact sketch of the chain of bones in the spinal column, and from then on there was no questioning the number thirty-one. More than that, the sketch showed what neither Andrea nor the great Galen nor anyone else had seemed to be aware of: it showed the true curve of the column and the exact angle at which the ribs and the lower parts met it. Only a draughtsman could have made these observations, and no anatomist had ever before been a draughtsman.

One night he was probing a skull. Neither Galen nor any other writer said what lay beneath the cheek-bones, and Leonardo put his chisel to them. As he later explained to Andrea when he showed him the sketch of the night's work: "When I took away that part of the bone which supports the cheek, the opening revealed two large cavities." In size these sinuses resembled the sockets of the eye, and in exploring them he found that they led through a small hole into the passages of the nose. Andrea could now understand the reason for certain disorders his patients complained of. He was finding in Leonardo's drawings unsuspected parts of the human machine, too many for his own comfort as a practising physician.

It was not always an easy matter to get at the parts of the machine by the crude means of a chisel, a saw, or a knife. Once, when Leonardo was about to drive his saw through a skull, it flashed upon him that by sawing into it he would destroy the delicate tissues inside the ventricles of the brain and he would never know them as they were. He laid down the saw and contemplated the specimen grinning in the torch flare. The shape of the human brain had never been seen. It would not do to break into the skull by force. To make an exact picture of the brain he must steal into it. His own brain groped for the way, and found it in his experience as a sculptor. He had often made moulds of a form. Now he drilled holes in the base of the skull and syringed the ventricles full of melted wax. When the wax

set hard he sawed through the skull, cleared away the soft parts of the brain, and held in his hand the first case of the ventricles of the brain.

The eye presented a similar problem: how could he handle it without losing its humours? Again he solved it like an artist. When he mixed colours he sometimes used the white of an egg to hold the mixture together. So he tried soaking the eye in the white of an egg. Now, when he boiled the specimen, a jacket formed round it and it was ready for dissection.

Step by step he was creating a new technique in anatomy. He pointed a long finger at a page of his drawings over which Andrea bent.

"These are four views of the long bone of the leg. Here is a cross section. At these points the muscles are attached. Here are the ligaments. Look at the network of nerves like white thread running through the fibrous mass."

The better to understand the machine he was dealing with he built a full-scale model, using wire for the muscle fibres and thread for the nerves. The body was an intricate system of levers and cords, hinges and valves, tubes and sacs—each with its special place and function. He himself had in mind machines he wanted to endow with nerve and sinew, arteries and joints. As he traced each tendon to its sheet of muscle, and each muscle to its bony shaft, he thought of his flying machine, and in the name of the Great Designer he prayed that he might be inspired to fit each part so nobly to its purpose.

He tugged at each tendon and felt the thrill of a discoverer when some muscle or hinged bone responded. For his friend Andrea he made the fingers twitch, the forearm bend up, the mouth scowl and smile. He showed him the muscles that pumped the voice through the windpipe. He removed the lungs and trachea, pumped air into them, and squeezed the spongy tissue of the lungs to observe how the system operated. He marvelled at the ingenious device of the shoulder joint that enabled the arm to swing in any direction, at the ball and socket of the hip, at the pivot of the neck.

For a time he gave his nights to a study of the organ that brought him sight of the world with its colours and shapes.

"Andrea," he asked slyly, "do you know, or does Galen say, what causes both eyes to move together?"

Andrea shook his head.

"Then we shall have to find out for ourselves. If we sawed a head down between the eyebrows . . ."

Andrea shuddered and fled.

Alone in the hospital Leonardo thought: "This is the body Nature has given us. To despise it as do some people or to ignore it as do others is blasphemous. Let us give praise and understand the body."

We see the world in three dimensions, we see it in a light that varies in intensity from dim starlight to brilliant sunshine. By what mechanism? He traced all the branches of the optic nerve back to their root in the brain. He went over all the muscles that regulate the size of the pupil. Suspecting that animals which prowl by night have a different eye mechanism, he once brought a lighted torch close to the eye of an owl, and noted that the pupil diminished to a point. When he withdrew the torch the pupil dilated until it occupied the entire eyeball. He studied the shapes of different eyeballs and calculated the angles at which they bent the rays of light that fell upon them. This led him to the use of glass lenses and spectacles to correct faulty sight. His final step was to build a glass model of the eye. At last he understood the mechanism of sight.

"Andrea," he remarked, "Galen must write about the heart muscle. Just what does he say about it?"

Andrea shot a look of suspicion at him. Master Leonardo sat with his chin meditatively cupped in his palm, but Andrea could not be sure that he was not smiling in his beard.

"The heart is not a muscle," he began, but as Leonardo made a gesture of impatience with his hand, he amended: "Galen writes, I mean, that the heart is a tissue."

"And how does he explain the flow of blood through it?"

"Flow? There is no flow. I mean," he added hastily, in deference to the warning start of his friend, "Galen states that the blood seeps through from one side of the heart to the other. It sort of ebbs and flows."

Leonardo did not reply directly. Then he asked: "Have you

ever seen how they kill pigs in Tuscany? They tie up the pig and with a borer, the instrument they use to broach wine casks, they stab through the right side of the animal, right into the heart. I have seen it done, and I have seen the handle of the borer throbbing rhythmically, moving to and fro in a line about as thick as my finger. That is the heart-beat made visible, or am I wrong?"

Andrea did not venture an opinion.

"Well, and what are we to imagine is the movement of the blood under that pulse, eh?"

"Galen says——"

Leonardo shook his head. "I have taken the heart out of its body. It is a muscle."

Andrea shrank from the details, and Leonardo was left as usual to find his way alone through the *terra incognita*, as Toscanelli wrote on the unexplored regions of his maps."

Life.

Life was many things. Physically it was a pulse in the body, a red stream poured through it by the heart pump. Could he prove that? He removed the bag that covered the heart. He opened it, and stood in awe before the most beautiful work of Nature he had ever contemplated, and the most complex. He dug into the maze of tubes, pouches, valves, determined to understand the heart machine.

He discovered that the chambers of the heart, two according to Galen, were really four.

As usual he must have a working model. He began with a wax cast of the artery of the aorta. From this he made a model in glass so that he could see with his eye how liquid flowed through it. He inflated the chambers. He perceived that they swelled up as the blood filled them, and contracted as the blood was expelled. The heart-beat, he imagined, was the sound of the valves opening and shutting.

"The blood . . . does it not circulate?" he asked one night. The heart under his questioning fingers was still. Only from its design could he guess the work it had to do. Exalted as he had rarely been by this specimen of supreme law in Nature, he drew out his notebook and wrote:

"You who by my labours look upon the marvellous works of Nature, think what an atrocious act it is to destroy a life."

Ludovico, it was rumoured, was killing his nephew the Duke by slow poison.

"He who does not value life does not deserve it," Leonardo wrote. He looked down at the moist pulp on the table. "Coarse men," he wrote, "do not deserve so marvellous an instrument. They need only a sac to receive food."

When he left the hospital the sky was already grey with dawn. Along the streets the shops were opening their doors. Two men came out of a basement, tugging at a load of breastplates and helmets tied up with cord. They stopped to stare at Leonardo in his velvet coat and silk hose. One of them said something in a low voice and the other laughed.

"Giuseppe!" a woman's voice rang out. "Your breakfast is ready."

He passed a young girl, hurrying along with an armful of wool. A goat skipped out of a courtyard, followed by a man waving a stick and fouling the clear morning with his curses. A child's cackling cries broke from the other side of a well. Not far from the castle he was hailed by a squat figure in a shabby velvet cloak. It was the poet Bellincioni, swaying like a broken tent in a gale.

"So-o! My Appelles," he hiccupped. "Who is the damsel, eh? The Prince was saying just to-night at supper—and what dishes, my master. Goose and roast boar and divine sausage. I swoon to think of it. And a wine, O call not wine this Olympian nectar sent by the King of Naples. 'Leonardo,' said the Prince, 'is indolent. We must summon another sculptor for the steed.'" He wagged his finger. "No, no, my Prince. Leonardo is not indolent." He wiped his mouth with his sleeve. Then he looked warily round and lowered his voice. "They say that Cecilia . . . Ludovico, you know, well, they say—" He swayed down the road, drooling:

"Her gown it was of silk and gold,
And on her breast there flashed a jewel.
Her charms they made the sun seem cold. . . ."

Life.

The corpse in the hospital did not explain it. He might know every atom of the lifeless body and still not understand if he knew not the living spirit without which it was only a flying machine without a flier.

He stopped to make a note. "Trace the nerves that affect breathing." Then added: "Also swallowing, yawning, sneezing. . . . What causes the sensation of tickling? What is the mechanism behind laughter and tears, fear and anger? What goes on in the body when we feel happy? What do we mean when we say: 'I am hungry. I am cold.'?"

When he reached his studio the morning was sunny and brisk. He felt it was late. There was much to do; he would have to hurry.

CHAPTER TWELVE

New World

HE was met by his housekeeper. "Master Leonardo," she grumbled, "there is again no money in the house."

Who could blame her for complaining? Counting students, apprentices, and occasional workmen, there were eight or ten mouths to feed, and Master Leonardo, bless him, too often with an empty purse. His workmen had to be paid, materials for his experiments had to be bought. The Prince was a grudging enough patron at best, tardy in paying for work done. When it came to requests for money in advance, he was very hard of hearing.

Leonardo covered up his unfinished model of the human body, and wearily went back to the sculpture of the Sforza steed. "I am a poor man," he reflected bitterly, "I cannot do otherwise."

Deep down, the marrow of his mind refused to acknowledge this, or to give up its adventures. If he went to the Duke's stables in search of a model for the steed, he found comparisons between the parts of a horse and the corresponding parts of a man: the muscles of the legs, the sockets of the eye. This led him not back to work on the Sforza steed, but to a comparison of the structures of a horse and a mule. This in turn led him to further comparisons. And all the time the Sforza steed could be compared only to a pile of clay.

Since his nights at the hospital, life had new meaning for him. He was like an explorer who discovers a new land and thereby sees the world in a new light, or like the astronomer who discovers new depths to star space and enlarges his view of the universe. The Sforza steed waited locked in the pile of clay while he wrote out all that he knew and could read about sub-human anatomy. Of animals in the country round about, such

as frogs, bulls, dogs, birds, horses, cats, he procured corpses for dissection. He was even able to buy the bodies of a monkey and a lion. He noted how much more powerful was the structure of the tree-swinging monkey's arm than man's; how much of the nocturnal lion's brain was taken up with nerves of smell and sight; how, where the human eye has one pair of lids, the bird's eye has also an inner transparent lid to serve as a wind-shield; how . . .

"Master Leonardo, there is no money in the house." His housekeeper was at him again. He made a few hasty notes for a quieter moment:

"Analyse the movement of the woodpecker's tongue . . . take out a bull's liver. . . . Compare the feet of the bear and the monkey. . . ." Then he was off to his studio on the roof.

He tried to focus his mind on the plan for the monument of Francesco Sforza. He would use iron for the armature of the mould. With every two cups of plaster he would mix one of burnt ox-horn. He would have the cast rubbed down with tallow. . . . But the beam of his mind was still playing upon the monkey's arm, the bird's wind-shield, the lion's olfactory nerve, and the supreme Inventor by Whose power they had their being.

Standing on the roof of the old castle he gazed upon the distant plain, firm and verdant in the April sunshine. The low roofs of the city were bunched in the midst of the plain; below him a gang of labourers were at work on the cathedral. He watched them dig, lug, hoist. A hoarse cry drew his attention to a knot of men standing on a wall. They were all straining at a rope, to the end of which was tied a load of sand.

Leonardo could not help thinking that here he was not witnessing a good example of man's intelligence. It was only an example of habit; the Romans did the same thing, and before them the Egyptians. Moles and ants, for that matter, were no less efficient. He watched the labourers. They used spade, crow-bars, and other tools which were only hand-gripped extensions of the bony levers of the arm. They were manoeuvred through the joints of the wrist, elbow, and shoulder. They were driven by the power of muscular sheets and cords.

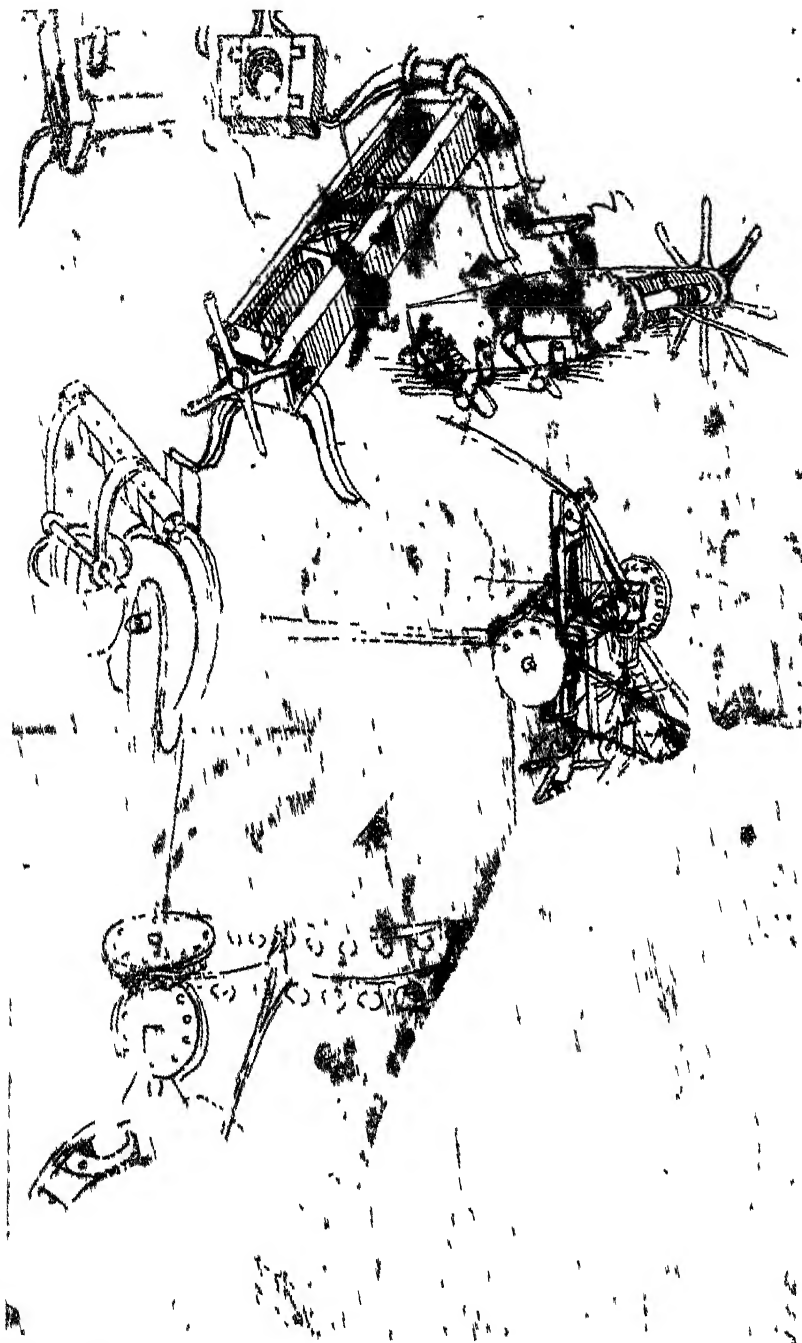
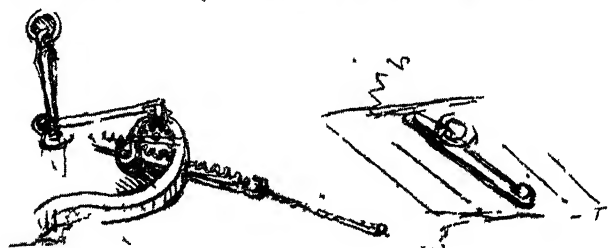
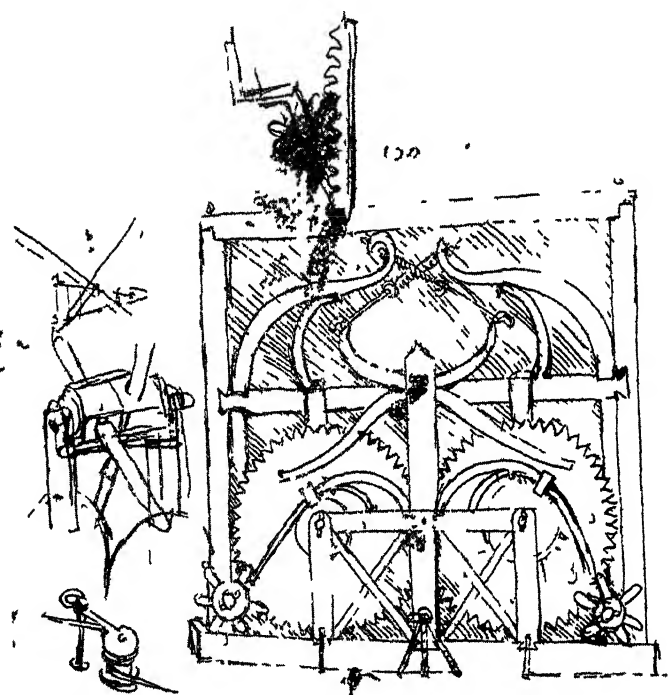
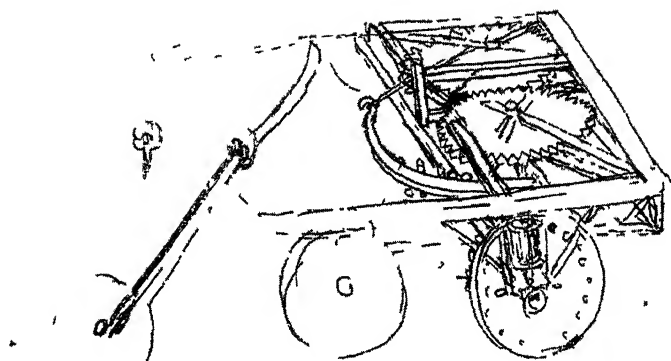


Photo by Anderson

DESIGNS FOR MACHINERY



SKETCHES FOR A MECHANICAL SAW

He took out his notebook and meditated with his pencil. He drew a few circles, then stopped, arrested by the geometrical pattern on the page. It came home to him that these lines and circles could stand for bones, ligaments, joints, or they might stand for wheels, spades, hammers. It made no difference what things—when you reasoned about them they became bare lines and curves. The truth of geometry embraced all things.

A bird is a machine working by mathematical law.

He saw how right he had been to say that. His flying machine, before it could give wings to man, must be made to work according to mathematical law.

Down below, his neighbours were sweating under weary loads. He fixed his eyes on a carpenter trying to force a nail out of a beam. The human body, too, he figured, was a machine working by mathematical law. And you could make artificial machines to do its work. His pencil flashed.

The carpenter relieved his inflamed feelings with an explosion of curses. High overhead, a man with golden hair and in smart attire was designing a little tool that would draw a nail quicker than one could curse it. It was a simple tool for a simple job: a pincers worked by a lever perpendicular to it, like the arm of a balance, with an upright support at the fulcrum. Yet, simple as it was, it led to further designs—pliers, wrenches, picks, shovels, drills—until he had invented a complete set of small tools. They were all arranged on the principle of the lever or the pulley whereby a small force applied at one end is relayed from point to point until, when it reaches the other end, it is many times magnified.

But what those men down below needed more urgently was relief from the heavier work put upon them. In all industry nothing was so brutalizing as the building trades. Egypt's Pharaohs hoped for immortality in pyramids, and the dukes of Milan for remission of their sins in cathedrals. But the hands that built the pyramids and the cathedrals prayed only for release from a life of labour. Leonardo watched the men put their backs under blocks of stone. He made quick sketches of human bodies in the act of straining and tugging. His eye was not dim with

pity; his pencil recorded the acts precisely. Only by knowing the line of action as it was could he ever be able to put a machine of wood and iron in place of the machine of flesh.

The men were sawing, lifting, lugging, hammering. Leonardo had to grasp the simple geometry of their work, because it did not matter whether flesh and blood, or wood and water, acted; if the geometry were the same the work done would be the same. In his mind the flesh of those lines became transformed into wood and metal, and the picture of one machine after another came off the point of his pencil. The human muscles that held the wood-saw tight became two rigid cross-pieces in a frame. He imagined a log clamped to a platform. The platform, riding on a track, was slid against the saw by the turning of a huge power wheel—and what turned the power wheel? It could have been a hand, but Leonardo thought of a stream of water, because the perfect machine was automatic. He drew blades to fit the rim of the wheel.

There was one problem he must solve before he could say to the men cutting beams with their sweat the livelong day: "I bring you your reprieve." The paddle-wheel upon turning was to move the platform. But how was the turning motion of the paddle-wheel to be converted into a horizontal motion of the platform? For the moment the Sforza steed stood in the way of the answer. His hungry boys stood in the way. So he put it down in his notebook as one more problem to work out some day. Meanwhile he went on with his rough ideas. On the pages of his notebook he sketched a giant corkscrew for excavating the earth, a boring machine for the manufacture of pipe conduits, a derrick, a grab for lifting heavy columns into place, a jack with rack-and-pinion gear for raising heavy weights. He had no need to stop. He could go on inventing machines without limit. He had invented nothing less than a way to make inventions. That was the one idea his mind moulded while his hands were busy with the clay of the Sforza steed.

He rode out one day to the little suburb Vigevano, where the Prince had ordered a new palace. The town was to be remodelled, and Leonardo's technical advice was wanted by Ludovico. After he had made a survey of the ground, he sat down on the banks

of the river—where soon the town would rise. The banks were wild with grasses, and, except for an abandoned house on the opposite side, devoid of human sign.

The day was fine, and, alone with the hills, the river, and the sky, Leonardo let his thoughts drift on the peaceful stream. As always, the flowing water put its spell upon him. In all the world only two phenomena had for him a spell of mystery: a smile, and moving waters. The surface that rippled under his eyes was stranger than anything else in the universe. He had known it to sweep down upon a countryside and uproot the tilth of a century. Now it was in a playful mood, but Leonardo observed a hollow under the house opposite, where the river was secretly washing away part of the bank. Here was the wildest force in Nature, the power of all powers to tame.

"That house," he thought, "—one could save it from the treacherous waters. More than that, one can make the river give back what it has taken. All we need to do is to sink dams at certain places in the course of the river. We can force it to drop its sediment where we please—under that house, for instance." His notebook was in his hand. "Why, we could lift the river up over those mountains." He made a sketch of the river equipped with canal locks and pumps, and of a ship climbing the hills.

He would have liked to go back to Milan and tell Ludovico about that ship. But he knew it would be no use. Ludovico Sforza was not a practical man like Leonardo. He was a dreamer, but without vision. Like all men of wealth and power, he disliked even a hint of change.

"Stop, man!" he would exclaim after one swift look at Leonardo's sketches. "Stop dreaming of impossible things." And he himself would turn back to his scheming and the impossible dream of keeping the world in his power for ever. Within a week he would send down a swarm of men. Almost with bare hands they would drive piles into the river-bed. They would roll barrels of water up the steep banks. By sheer sweat they would dig out tons and thousands of tons of soil and haul them away.

That was the scene Leonardo would have changed. He drew plans for a mechanical shovel, consisting of load cages which

could be raised mechanically, swung away, and dumped out. He designed a pile-driver: a winch that lifted a huge weight and dropped it automatically when it reached a certain point in the air, thus striking the pile with a force great enough to embed it. He designed a crane for loading and unloading. He conceived a pump which pleased him because it was automatic: the wheel that worked the pistons could itself be turned by the very stream it pumped from.

He rose and put away his designs. It was a sad thing for the world that he could not go straight to the castle with them. But the Prince would only stroke the bulging satin of his bosom and wink at his secretary. He fancied that he had more important things to do than indulge the whims of mad genius. Leonardo might plead:

"These are not toys or idle fancies, my lord. They have the authority of science; they need only yours. Give me the money to build them. A new world, my lord."

He would plead in vain. The Prince would look at him as though to say: "And where should I be in your new world, eh? More than Prince? And tell me, my master, can you design me a machine that will dispose of the young Duke? I mean no evil, you understand: I love my nephew dearly. Can you design me a machine to dispose of the French army or the Venetian ships? I mean no violence, you understand. I am no soldier as my father was."

Aloud he would say: "Not now. There is no money in our treasury. And the steed? The abbot of Santa Maria delle Grazie is impatient for his picture of the Last Supper."

"No, better keep the new world to myself," thought Leonardo. But inside, it made him restless and he imagined its ghostly shapes like dawn in the byways of the city.

He happened to visit a monastery where the friars made and sold cloth. The work was done almost altogether by hand. For this eternal occupation of man there were only two mechanical aids: a hand-wheel for turning the spindle upon which the yarn was wound, and a weaver's frame, too crude to be called a loom. Here was a virgin field for the mechanical engineer. Leonardo watched a friar at a spinning-wheel. He was drawing out the

raw fibres, twisting them together, then winding them on the spindle. The hand-wheel merely helped to turn the spindle.

How could this process be made automatic? What shapes of metal and what gears could perform the motions of the spinner? Leonardo's answer was a new kind of spinner: a flier. This, as it rotated, both twisted and wound the yarn on a spool, and the spool was so geared that it moved up and down on its shaft, thereby distributing the yarn evenly.

The flier spindle was only a beginning, and before Leonardo turned his attention away from the textile industry he counted in his notebook a few dozen looms, a rope-making machine, and a needle-sharpener that could turn out forty thousand needles every hour.

He went down to the street of the armourers, for whose products Milan was famous. Europe could not get enough of them, and no wonder. A man had only two hands, and shaping iron was no light summer job. Before he left the street, he had added another page to his notebook, and on the page a sketch of a mill that could roll a bar of metal into thin sheets, and one that could ream it out. For grinding and polishing metal surfaces, he geared smooth-stone tools to a water-wheel.

One day he sat down in a restaurant, where he happened to notice the cook turning a joint of beef on an open fire. The savoury vapour rose in a cloud to put a finer edge on his appetite. But it also stirred something in his memory. Years ago in Florence he had designed a steam gun. More recently he had experimented in his studio with steam pressure.

"What is grander than a well-roasted joint of beef?" thought the hungry philosopher. "But if the cook were free to leave the joint, I might get my soup the sooner. Wait; the cook could be free. Suppose we hang the joint on a spit? We gear the spit to a kind of vane fitted in the chimney. Under the vane we put a vessel of boiling water. The vessel is sealed except for a tiny hole from which a spray of steam shoots against the vane. The steam rotates the vane and the vane turns the roast. Ho, there, Giuseppe! Here's a present for you: a design for a meat-roasting jack. Get the blacksmith to make it up for you. With the time it will save you you can learn to make better salads."

The cook was not the only one to benefit by Leonardo's lighter moods as an inventor. Marco, a nineteen-year-old pupil who stayed with him, was another. This youth had two gifts—one for painting, and the other for sleeping in the mornings. He himself deplored the habit, and was horrified when he awoke to see the sun already high in the heavens. One night he found a strange contraption at the foot of his cot, a kind of low trestle supporting a board which reached a little way under the cot. On the far end of the board there was a basin. Right above the basin was fixed another board and a basin into which a thin stream of water trickled from a funnel.

"You needn't worry about wasting your morning in bed," said Leonardo, patting his head. "You will be awakened early. Good night."

Marco went to bed. Suddenly he was jolted hard out of a sound sleep—he almost fell out of the bed in fact—and he sprang to his feet with clenched fists. There was no one else in the room, but he noticed that the board, which the night before had lain flat on the trestle, now stuck in the air.

"It works!" cried Leonardo. The board, with the water-basin on it, was so balanced that when the water reached a certain level it tipped the board, which kicked the foot of the cot, and woke the sleeper.

Leonardo, when he looked over his designs, set his heart on building the machines, though not immediately. Before they could operate efficiently he still had to give much study to them.

His chief concern—the transmission of power through the parts of the machine—depended on mathematics. The fate of his flying machine depended on it. The control of natural force depended on it. He determined to devote some time to the study of mathematics.

He had a vision of a new world. It would come one day, when by the machine mankind would be clothed, fed, housed, and thus set free.

"Master Leonardo"—his housekeeper broke in harshly—"a messenger from the court."

The Prince required that Master Leonardo should report to the city of Pavia.

Leonardo put away his pages of machines. There the new world would have to remain on paper, next to his model city. And the Court of Milan would never permit it to come out of its paper stage. The court's business was to amuse itself, to carry on intrigues, and to resist social change. The court was not concerned with freeing men.

Disheartened, Leonardo packed his things. "Come, Marco, we go to Pavia, you and I."

There was a whoop of delight at the news.

CHAPTER THIRTEEN

Pavia

FOR four hours they rode through a valley, fair and murmurous with summer. Through the woods on either hand they caught frequent gleams of water, and the road before them sloped gently down so that they always had sight of the horizon. The long perspective raised Leonardo's spirits. He was at home among spacious views and he flicked off the sting of the Sforza Court as his horse flicked off flies with its tail.

Marco pointed to a tower that rose above a distant wood.

"Yes," said Leonardo. "The castle."

The tower, as they approached, became one of four connected by jagged parapets, like bared teeth. The castle, which stood in the midst of a park, was then unoccupied. The dukes of Milan had used it only as a retreat for a season of hunting and pastimes not suited to the formal air of Milan. It was one of Leonardo's jobs to help to remodel it as a home for the sickly Gian Galeazzo and his duchess, Isabella. The architects had to see to the banqueting hall, the ballroom, the reception hall. With the dungeons and torture chambers below these gilded stories they had nothing to do.

Past the moat of the castle, the town had a quiet, medieval charm. Its walls were stained and cracked, like the face of an old man beaten by the winds of the ages and moulded by their wisdom. It had been a university town for almost seven centuries and possessed the best collection of manuscripts in Europe. Deep in the woods and by the waters of the Lombard plain Pavia studied its old books and took care of its relics, among which were the tomb of a Christian saint and the statue of a pagan horseman.

Leonardo, who had a professional interest in equestrian statues, went at once to the public square to see this one. He was rarely

moved by works of the human hand, as he always was by Nature, but this statue impressed him.

"They say that a live horse, seeing the statue for the first time, sniffs at it," he said to Marco. "The sculptor knew his business. Do you notice what a free, balanced movement it has? That's because the sculptor modelled it in the natural act of trotting. I am afraid that my own horse, which rears up in the air, is impossible."

The sculptor was unknown. Legend identified the subject of the statue with a Gothic king who had once invaded Italy. What became of him or his men even legend did not bother to say. Italians were as accustomed to invasions from the north as they were to rivalry among their own dukes. It was, in fact, the rivalry between the lords of Milan and Naples, of Florence and Rome, that invited bands of armed immigrants to Italy. Through the ages, not only this monument and others, but the fair skin of Leonardo and the slyness of Ludovico were the result of such invasions.

Leonardo found that the sly Ludovico had sent two other architects to Pavia and, knowing that the contract for the work was awarded to whoever had his plans approved first, he got down to business. The principle of designing a castle was to make it as imposing as a cathedral and as safe as a fort. To plan for the safety of the Duke was at times a bit trying. When it came to the floor plan of the ballroom, Leonardo had to consider where the Duke would sit so that no one could pass behind him: it would never do to have the ducal back exposed. When it came to the stairways he had to adopt the plan of not connecting them, so that the guards in different parts of the castle would not be able to conspire together. When he drew plans for the outside wall he put towers at each corner where soldiers could pick off an enemy scaling any parts of the wall. The safety of one man in satin breeches complicated the deeper problems of structure and form. An architect might stand up and say:

"My lord, see to it that the people have reason to love you, that your dealings with other governments are friendly. You would thereby solve many problems of structure."

Leonardo did not say that, but he did more than concern himself with the Duke's life. He prepared for the Duke's death by designing a vast mausoleum. No one asked him to do it. But the more he thought about the Duke's career, the more he thought about a mausoleum. It was to be the most elegant granite home of death, whether that death came by assassin's dagger or by disease. The Duke, when he saw this page, would hurriedly pass it by.

Now Leonardo put himself at the service of Ludovico's younger brother Ascanio, who was Bishop of Pavia. To ensure their power, the ruling families of Italy, as elsewhere, had to control the conscience of the people, and the Bishop was building a magnificent cathedral. For a time Leonardo was busy with the structure of domes, chapels, pillars, apses. He made countless designs of cathedrals, in the usual form of crosses. But he was not satisfied with the usual form.

The people of Italy were just then being stirred by a most unusual Churchman. He was a man of the same age as Leonardo, a small man with a furrowed brow and flashing blue eyes. His name was Girolamo Savonarola, and he went about preaching reform in the Church and State. The Church must be cleansed of its worldliness, and the State must be made democratic—so preached Savonarola, and the people flocked to him in great numbers. . . . Leonardo added a page to his plans for a church. Instead of a cross he designed an open-air amphitheatre, with curved rows of seats rising one above the other. In the centre he put a pulpit and off to one side a choir. He topped the structure with a vast dome and called it: *A Place for Preaching*.

When he had completed his designs he should have packed them up and rushed back to Milan to haggle over the contract with Ludovico. His rivals, the other two architects, did that. But he had come across a few interesting manuscripts in the library, especially a new book on algebra, the first of its kind ever to appear, and for the sake of his machines he had to read it. Then too, Marco was so happy in Pavia, tramping through the woods and swimming in the river, that it would have been a shame to tear him away. There were other reasons, good or bad, for staying on and on in Pavia. Leonardo admitted to him-

self that he did not want to go back to the Sforza Court, and he was simply finding reasons why he should not go.

He forgot Milan. He made friends with a certain professor, Fazio Cardano, who had translated from Latin a book on the science of perspective. That book started a long and hot discussion between the two men. The professor argued mostly from books, Leonardo from natural events. Once Leonardo lost his patience and said: "Isn't it strange that these old authors of yours speak so much about things no one can prove, things like the soul and heaven, while they ignore facts under their very noses? Here you quote me an old author, who states we are able to see because our eyes are like lamps in that they send out rays of light. Have you verified his statement? Has he? No. Experience is the final authority, and my experience with light and the human eye teaches me that your author is mistaken. I, too, must write a book on the subject."

"So that people can quote you," Cardano laughed unpleasantly. He was a skinny little man with a bald head and a toothless, crooked mouth.

"At least," Leonardo retorted, "I shall prove my statements."

He set to work on the book. Milan and Ludovico might have been on the moon, for all the attention he now gave them. The ten days for which he had come to Pavia passed into fleeting months, and Leonardo had one purpose: to write a clear and true account of the science of optics. No one had ever done it satisfactorily because no one had ever been both an artist using perspective, and an anatomist knowing the human eye. Leonardo wrote with the feeling that here was the most wonderful theme in the world. For the whole world was contained within a spot in the eye no bigger than a point.

Since he believed that we really know only what we experience, he took great pains to appeal to the experience of his reader. He himself was merely a guide through the mazy paths of Nature. "But do not trust me," he seemed to warn the reader. "See for yourself. I can only point out what you are to look for. The sun is blazing on the water, a candle is throwing shadows in a room. What do you make of it? So. Let us make

sure by putting it to some test." And he cited the experiments that led him to his conclusions.

He talked about his book in the professor's study and it was like throwing open a window in a stuffy room. The professor, in fact, found it quite draughty, and now and then squirmed irritably. The pages of his books rattled and the dust whirled.

Leonardo once brought a ball, which he fell to bouncing up and down. Turning to the professor, he remarked: "That is how light behaves, like that ball."

The professor looked blank.

"I find," Leonardo said, "that the angle at which the ball bounces off the floor is equal to the angle at which it hits the floor. So with a ray of light when it strikes a surface like a mirror or a sheet of water."

The professor hesitated. "I have not come across it," he said.

That was true. There were many things Leonardo brought up that the professor had never met with in his reading. The professor was interested in the science of light, but he did not think that the human eye had anything to do with the subject. When Leonardo asked such questions as: Why does a cave appear dark when you are looking into it from the outside? or: Why to human sight does the world appear in three dimensions? the professor was quite unprepared. When he heard the answers—that the size of the pupil of the eye is regulated by the amount of light coming to it, and in the bright outdoors the pupil is too small to see into the cave; that we see things in the round of three dimensions because each eye focuses on the same object from a slightly different angle—when he heard these answers the professor felt that such homely matters were off the subject.

One evening Leonardo darkened the room except for a small lamp. He punctured a hole in a sheet of paper and invited both the professor and Marco to look at the lamp through it. "Can you see," he asked, "how light rays form a cone?" He covered the lamp with the paper and showed that after passing through the pinhole the rays spread out again on the white wall. "Light acts in straight lines, you see," he remarked. "I have another test for that."

He had constructed a large, stout box, completely closed except

for an iron shutter with a small opening in it. He lined the side opposite the opening with thin white paper. On a bright, sunny day he carried the box outside and put it down facing a building in the square. "The white paper inside the box," he demonstrated, "shows the image of that building." But the curious thing about the image was that it was reversed as in a mirror and always upside-down.

"We see the building only because it reflects the light that falls upon it," Leonardo explained. "Since light travels in straight lines, the rays from the roof of the building enter the box in a downward direction and fall on the lower part of the screen. The rays from the ground floor similarly go to the upper part of the screen: the image is therefore upside-down, but we have learned by experience how they really are, and interpret them right side up."

"I wonder," said Leonardo one evening, "what effect water has upon a beam of light." He frowned, then spoke a bit hesitantly: "We might take two jars, one smaller but otherwise identical with the other. We put the smaller into the larger and a layer of water between. We paint all the outside except for a small spot, the size of a pea. Then we can follow a beam of light entering the jars, and observe how it is bent by the water."

For Marco, one evening was more delightful than any other. That was the night that Master Leonardo demonstrated his tricks of optical illusions, of which he knew a great many. After one of them, when he picked up a burning brand and swung it round and round so that it looked like a ring of fire floating in the room, he remarked that it was a question of the eye's being quicker than the mind.

"We should clear up so much mystery about our world, if we but knew more about light." He spoke of the movement of the stars, the physiography of the moon.

"If we lived on the moon—"

Marco at once accepted the thought.

"—the earth would appear to us as the moon does now," went on Leonardo.

Marco tried to imagine it.

One of Master Leonardo's boldest ideas was that he could

calculate the distance to the sun by means of images thrown by sunlight on a screen, but that scientific stroke must wait until he had acquired some skill in mathematics. For strangeness, however, one could not equal his saying:

"The sun does not move."

That was heresy, said the professor, but Marco trusted Master Leonardo. If Leonardo said the sun did not move, why, he must be thinking of some delightful trick or experiment.

Only once did he hear the master say something that shook his faith a little. They were strolling along the outskirts of the town late one afternoon. Leonardo had stopped to watch some birds. The tawny bush of his head was lit by the low sun, and he shaded his upturned eyes with his notebook. Marco had often seen him in this attitude, following some bird with his eyes. This time he was intent upon a dark speck moving about the sun. Just then Marco heard a rustling among the branches of a tree, and whispered excitedly:

"Master Leonardo, look, a sparrow!"

But Master Leonardo seemed not to hear. He was writing. "That was an eagle up there, Marco," he said a moment later.

"Yes," said Marco carelessly. "I was observing a sparrow, myself."

Leonardo looked sharply at him. Marco felt his blood rising, and to cover his confusion asked: "Why do eagles fly so high? Sparrows don't."

"Sparrows are small birds without much plumage. They would find it too cold in the upper regions. Then their wings are too small; they have to stick close to earth where the atmosphere is dense." He put his arm round Marco's shoulder and said playfully: "If you want to fly high, when we get back to Milan I shall make you a pair of wings with which you can chase the clouds."

Marco smiled gratefully. But he did not know how to take the remark. In Milan he had heard it said that the master was really building a flying machine. One heard all kinds of tales, but Master Leonardo himself seemed to confirm this one.

"Ho, ho!" said a harsh voice behind them. "I did not know you were devout, Master Leonardo. So you do believe in angels."

It was the professor, in his purple jacket, and with his toothless, angry face. Leonardo stared coldly at him. "I believe that mortal men can fly," he said briefly.

"With artificial wings, eh? An old dream in the heart of the foolish," replied the professor. "But even you who are so wise are haunted by it."

Marco could have twisted the beak on the leering face.

"You have doubtless in your Florentine days seen the bas-reliefs of Giotto," went on the professor. "Do you recall the one of Daedalus putting on his wings?"

"I have seen it many times," replied Leonardo. "The plumage is not correct."

The discussion went on. Marco began to wonder if Master Leonardo was not touched with the sunstroke of genius.

"So you will attempt to fly some day?" challenged the professor.

Leonardo nodded.

"Then you will fail," said the professor harshly.

CHAPTER FOURTEEN

A Boy in Pavia

EARLY one morning Leonardo and Marco went walking through the countryside. They had reached the edge of the town when out of an alleyway a small boy dashed full tilt into them. Leonardo's long arm shot out and scooped him up into the air, where the lad hung, too startled to struggle. Never was there a more ragged child. He was not naked but he wore no single recognizable garment. He must have been about ten years old.

"Well, my little man," said Leonardo in the liquid tone that gave his speech the air of a serenade, "what's your name?"

"Giacomo," the boy said in a surly soprano.

Leonardo put him down and patted the curly head.

"And where do you live?"

Giacomo waved a hand towards the public square. "Over there. In that big stone palace. My father and I live in that big stone palace."

"With all your brothers and sisters?"

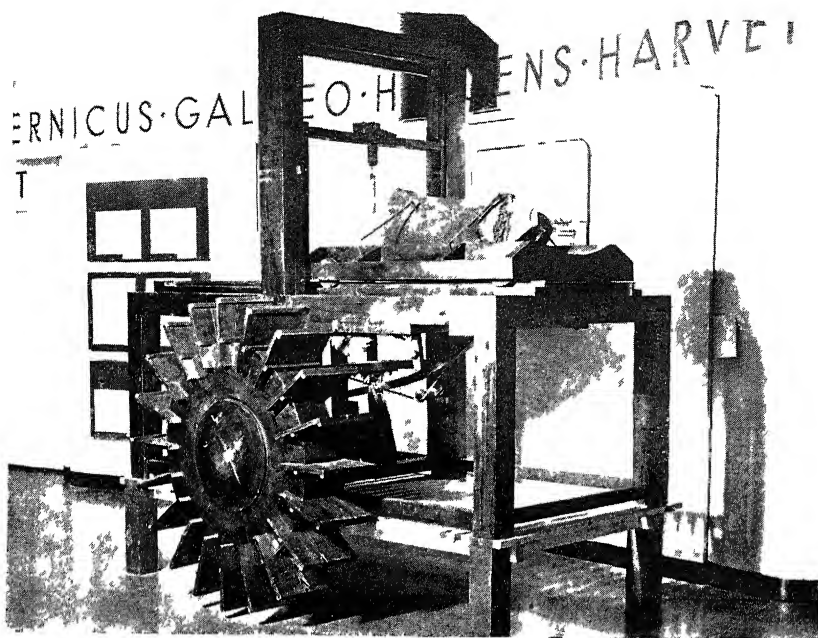
"No, no. I haven't any brothers or sisters," the boy screamed, and dashed off.

It was a fine morning, with a strong sun in the eastern sky and the meadows sparkling under it. There was a glow in the tall grass and the leaves had put on fringes of light. Marco began to sing.

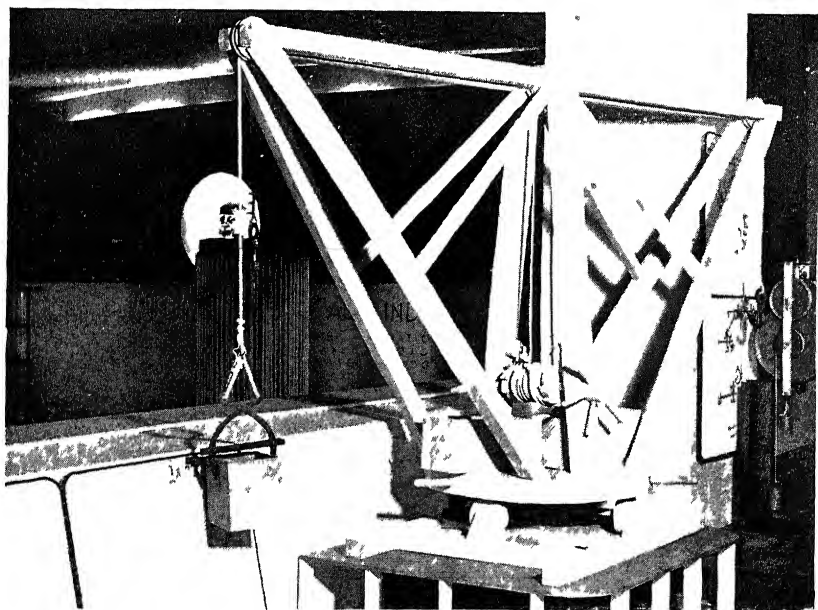
"The foliage is always transparent like that," broke in Leonardo, "when it is between you and the sun."

He pointed behind them to a dusky haze, like a patch of night. "When you are between the landscape and the sun, however, you see the difference."

Marco checked the song. Master Leonardo, he thought, was a bit heartless to thrust his science where it did not belong, like



Automatic Saw



Pivoting Crane with Two Arms

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Above : CARICATURES BY LEONARDO (c. 1490)

Below . CARICATURES BY A PUPIL OF LEONARDO

a spinster aunt at a party. Once he had been a great artist, but these people must be right who thought that he had become cold and hard. He never thought of painting any more. Science had warped his sense of beauty, thought Marco a bit resentfully.

To reach the river they had to pass through a wood, damp and shadowy, and Leonardo stopped in the thick of it. Marco chafed at the delay, for on the other side of the trees the wind was sporting with the water. But the master liked shadows, not sunshine, and he was saying that they changed in shape and hue, depending on one's position, that of the sun, the slope of the earth, and other things to which Marco was deaf. Suddenly, when his attention was fixed as intently as it could be upon the distant patches of light through the trees, the master addressed him.

"What colour do you think those leaves are?"

"Green, of course," said Marco shortly.

"They seem quite yellow to me." The master's voice had a note of disappointment. "We are facing the sun, you see. Then the wind is turning up the lighter under-surface of the leaves."

"I see," said Marco sullenly.

"Then, too, walnut trees are naturally yellowish. Their green is different from the green of that laurel over there."

"I see," Marco muttered. Was he a painter or a botanist that the master expected him to learn such things?

Leonardo interpreted his thought. "You must know these things," he said gently. "There is more in art than Madonnas' eyes and gilded halos."

Then he pointed out how all the trees round them differed from one another: how the walnut bent its boughs, how the willow was suffused with light, how the leaves of the elder were in twos and crosswise one above the other. The master's notebooks were full of such things. At the moment he had his notebook in hand, and his eyes upon a cherry tree.

"It is like the fir," he said, "in that its branches arrange themselves about a stem."

He explained that leaves and branches did not come out in hit-or-miss fashion. There was a regular order, Leonardo had discovered.

"The branches," he said, "never cover one another. Nor do the leaves, which turn up to the sky to catch the dew. They arrange themselves in such order that they can share the sun, the air, and the rain. You can see the idea here." He took hold of a branch. "This leaf is oblique to the one directly under it. The same with the leaf above it. Now we come to the fourth leaf, and you see how it is directly over the first one, the fifth over the second, and so on up the branch."

This kind of talk exacted a good deal of attention. No other artist, thought Marco, would dream of painting a woodland scene from Nature. And if he did he would not dream of approaching it with a ruler. Marco could not rid himself of the uneasy feeling that such an approach was too cold. Where was that fire of emotion with which the artist was supposed to burn? Yet when Master Leonardo touched a canvas with his brush, he inspired it with life like no one else. And that was the paradox that plagued Marco on the way home, when the fields lay under the soft dusky light that the master preferred because, as he said, the world then stood clearly revealed to him.

Beginning with that day, something else besides a paradox came to plague Marco. The master had taken a fancy to the ragged urchin Giacomo. The boy's parents were very poor and were flattered out of their wits that the famous Leonardo should profess an interest in him. They lived in a shanty and Giacomo had many brothers and sisters. This should have disappointed Leonardo in the boy, yet from then on the sight of the tall, spare figure accompanied by the small boy became familiar in the streets of Pavia. By his countenance Giacomo was an angel; by his conduct an imp. He was young in years and old in vice. He told the truth only if it could hurt someone, and was never quite trustworthy when awake. Even the indulgent Master Leonardo would soon have to drive him away, thought Marco.

One day Leonardo took him to a shop where he had ordered two shirts, some hose, and a doublet for him. The master took out his wallet to pay the bill and laid it on the table. When later he picked up the wallet he found it empty. There was no doubt who was the thief, though Giacomo stubbornly and shrilly denied it. Some days afterward Marco missed his silver pencil, and

found it hidden away among Giacomo's things. Marco at once told Master Leonardo, thinking surely the little rascal would at last be turned out, but Master Leonardo listened sadly, and never said a cross word to the boy.

Often when the master was quietly working the imp would fling open the door and tug at his arm, clamouring, "Tell me a story, Master Leonardo, tell me a story!"

Leonardo would lay down his pencil and tousle the boy's head. "Very well, listen. There was once a wicked spider who used to prey upon poor little flies. One day he was climbing a grapevine and, looking down, spied a bunch of grapes. 'Aha!' said the wicked spider. 'All the flies in the neighbourhood will soon be coming to it.' So he spun out a fine thread and lowered himself into the grapes, where he hid. Alas, he was right. The wicked spider had so many victims that he gorged himself and fell fast asleep in his lair among the grapes. That was a sad mistake for him and a happy day for the world of flies, because the farmer came along, cut down the grapes, and crushed them for wine. So perished the wicked spider."

Giacomo, who was a little glutton, used to eat enough for two, and at times was very sick. After an attack of the colic, Leonardo invented this story for him:

"A gaudy butterfly was flitting through the darkness when he was attracted by a light. He thought he had never seen anything so radiantly beautiful, even among the flowers of the field. So round and round it he flew. When he got near the flame, do you know what happened? It singed the tips of his wings. The butterfly was hurt, and also a little puzzled. He refused to believe that so lovely a thing as flame was harmful. Up he rose, and flew right into it. Poor butterfly. He died, you see, because he didn't know how to enjoy a beautiful thing."

Before the little scamp Giacomo Salai interfered, Marco was happy in Pavia. Now, after six months, he longed for the gay piazza in front of the cathedral in Milan. He could not stand another evening of the pest's chatter. No, he was not a bit jealous. He just could not see why the master gave so much of his time to the imp. It was his turn to crow when a messenger arrived from Milan to remind Master Leonardo that he had been

away six months, and to inform him that the Prince was about to be married and ordered an entertainment for the occasion.

Marco was happy until the little imp came dashing towards him with the news that he, too, was going to Milan. Yes, the master had proposed to Giacomo's parents that they put the lad in his hands to be educated. So, much to his disgust, all along the road back to Milan, Marco had to listen to the story of the giant who lived in the sea.

"And this giant came on shore and fell asleep. When he awoke, he felt a tickling in his hair, and putting his hands on his head, pulled out many crawling vermin called men. And the giant let out a roar-r-r-r. . . ."

CHAPTER FIFTEEN

Man on a Horse

THEY entered the city by the same gate through which forty years before Francesco Sforza had invaded it. Leonardo brooded over the image of a man on a horse. Forty years ago the horse had ramped, the horse had plunged, the horse had stood quiet. The man on his back had swung a mace; the man had shouted an order to his soldiers; the man had sat quietly looking out over the plains of Lombardy. Now one of these many moments in the story of the man on a horse would have to be made its eternal moment. Leonardo had to choose.

But first the wedding. . . . Ludovico was making it a double wedding. He had a reason. The Duke, poor fellow, was very sick. And if the worst happened to him the Duchess Isabella's father, Duke of Naples, would claim Milan for his daughter and her child. So on the political chessboard the Duke of Naples could call check on Ludovico. But Ludovico played a good game, by himself espousing Beatrice d'Este, daughter of the Duke of Ferrara, and by arranging at the same time the marriage of the Duke of Milan's own sister, Anna, to Beatrice's brother. Ludovico thus moved the Duke of Ferrara into a position threatening the Duke of Naples.

"Sire," said Ludovico's astrologer, "the moon is in the House of Aries; it is a propitious time for weddings."

"Summon Leonardo," Ludovico ordered. "Summon all the leading artists of Lombardy. Impose a fine of twenty-five ducats on any one not attending. We must have a festival second to none. All our castles are to be renovated. The walls are to be frescoed with the victories of my great father."

Leonardo cared no more for the Court's spectacles than for Ludovico's politics. To him Ludovico's victories were of no importance. If he won, it was only because the Duke Gian

Galeazzo lost. The people of Milan were not touched either way. Men on horses, Francesco or Ludovico or any other, bought and sold them and lived at their expense. It was all one to them who was the buyer and who the seller. Once, in 1450, they had driven out their Duke and proclaimed a Republic. But Francesco Sforza had trampled upon it. Whether his son Ludovico could keep the spoils was his affair, not the people's. Seeing Ludovico surrounded by his guard, Leonardo thought: "He has nothing, so long as he can lose what he has." He himself meanwhile had a hundred experiments waiting to be tried, a hundred plans for a lasting conquest in which all the people would share, now and for ever.

But for the time he was Ludovico's entertainer. He put all questions of power wheels and driving shafts to one side, and brought out the gold paint and feathers. Little Giacomo, at least, would find the spectacle amusing.

Leonardo took the lad everywhere with him. He had bought him attractive clothes, and people said the boy was just a curly-headed angel brought down to earth by Master Leonardo. At that Leonardo smiled tenderly, but he thought that, if his Giacomo were an angel, he had fallen very low. How those dimpled hands could steal; how those arched lips could lie!

Leonardo had designed a pageant in which a wild Tartar tribe were to ride on horses and play strange music on a sort of bagpipe he made specially for the occasion. The men came to Leonardo one day to try on their costumes. They took off their clothes, laid them on the bed, and changed into the Tartar costumes. When they went back to their own clothes one of them cried out: "I've been robbed. My money is gone!"

Leonardo looked round for the curly-headed angel, but he had fled from the room.

The pageant was very fancy and childish. Giacomo, like Ludovico's noble guests, was wild with glee at Master Leonardo's band of Tartars.

"Oo!" he screamed at sight of the golden saddle-cloths painted with peacock's eyes, the shields with flashing mirrors, and the helmets on which a peacock spread its tail over a golden ball.

"Bravo!" shouted the noble guests.

The tax-gatherers threw uneasy glances over the wall of the courtyard: pageants cost money. But at that stage of the game Ludovico was not thinking of pawns.

The people at court often spoke of the strange world in which Master Leonardo lived. Yet nothing could be more unreal than the court itself. It was tricked out in velvet and gold, as though life were a masquerade ball. Now and then there was a flash of steel, and now and then the laughter died down. Round plashy fountains and in marble pavilions the talk went on in whispers:

"Have you heard? The Duke is dying of slow poison."

"Be careful."

"Have you heard? Beatrice and the Duchess Isabella are at daggers drawn as to who is mistress. Isabella is furious. She will have to live in Pavia with a dying man, while her rival reigns in the capital here. Ludovico——"

"Be careful."

"Have you heard? An envoy has been sent to Germany to Maximilian, the Emperor's son, offering him the hand of Bianca Maria Sforza and a huge fortune as dowry. A crafty move. Ludovico——"

"But be careful. There goes Master Leonardo."

From this unreal world Leonardo took refuge in the stables in search of a model for the Sforza steed. It was good to be rid of the court pageantry, and good to take up again an art form he had not practised since those days in Verrocchio's shop when he used to mould heads in plaster.

Among the horses owned by Ludovico's army chief he found a model. It was a powerful animal and of good proportions, with massive haunches and a steeply arched neck. Of this horse he made action studies, ranging in degree from a nervous lift of one foreleg to a convulsion which flung both legs high into the air. Which one of those poses revealed the mood of the rider? The traditional pose of this sort of monument was one of quiet dignity, but Francesco Sforza had been a man of violence, and his portrait ought to reveal it. Leonardo tried a few sketches of an idea for a prancing horse with the rider pointing his baton rearward. But, when he stood off and contemplated it, the figure

lacked balance, he thought. The trouble was with the emptiness under the raised forelegs.

He sketched the trunk of a tree under the raised legs. A moment later he rejected the thought. "No," he decided. "There is no convincing reason why a tree should be under a prancing horse. What motive can I give the horse for rearing up on its hind legs?" Why, a menacing foe, a fighter fallen in the horse's path! He changed the rider's gesture from pointing a baton to swinging a mace down upon the head of the foe. But the figure still seemed out of balance, as though it were just about to topple off its pedestal. And it actually might. Leonardo calculated that, when it was cast in bronze, the colossal figure would be twenty-six feet high and weigh no less than two hundred thousand pounds. Tilted at an angle, such a mass might in time become unstable. Well, he would have enjoyed facing the engineering problem if only the artistic design had pleased him. But it did not, and he finally planted the horse firmly on the ground.

"Yes," he admitted, "the sculptor of the horse in Pavia was right. And Verrocchio with the Colleoni statue in Venice was right. A violent pose would be unpleasant in a monument."

He had an iron armature built, ordered the clay to be prepared, and began modelling the figure of the man who had risen from the rank of a common soldier to be Duke of Milan. The sculptor had never seen the man, for Francesco had died when Leonardo was a lad of fourteen, but as he moulded the plastic earth he kept in mind a character whose arm had been the scourge of all against whom it was raised.

"Is this," he wondered, as he roughed in the face, "the jaw of the professional hero? Is this the hawk-like image of the commander who, in the pay of the then Duke of Milan, led his men against the Venetians and, later, in the pay of Venice, marched against the same Duke? Is this the carriage of the man who agreed to defend the infant Republic of Milan only to crush it? Is this the glance of the soldier who, capturing a dukedom, maintained it by wise diplomacy for sixteen years till the day he died?"

The clay took form.

In September of 1493, Francesco's younger son sent word to Leonardo that he wanted the monument to be finished by November. Ludovico Sforza had made another move on the political chessboard. The young Duke was sinking; the moment was rapidly approaching when a new duke would have to be named publicly. Ludovico feared that the Duke of Naples would not like the name of Ludovico. But even more he feared the King of France, for the mother of the dying Duke had been a French princess and the French King might claim Milan for himself. The claim itself did not matter; the French army did.

Ludovico looked round, and his attention fell upon Maximilian I, the widowed son of the aged Frederick III, Holy Roman Emperor. He looked again and, right under his eye, stood his own unmarried niece, Bianca Maria Sforza. A good move, he thought. He spoke at once to his tax gatherers about a dowry of four hundred thousand ducats. They almost fainted from the shock, but he insisted. The people? Better times would come when he had the Duchy safe in his pocket, which would be when Maximilian became Emperor in his father's place.

The wedding was set for November, 1493. It was to be celebrated with the usual round of festivals, and, as a special symbol to the world of the dominion of the Sforzas, Leonardo's monument of Francesco Sforza was to be displayed at the time of the wedding.

Leonardo sent back word that he would have a plaster cast ready for the occasion and that the bronze cast could wait. Like all good craftsmen he did not like to work under pressure of time, and he did not intend to now: a public ceremony was one thing, and good workmanship another. Suffice it that on the wedding-day he would exhibit the image of a man on a horse. None but himself would know the unfinished state of the statue, and he could finish it after the crowd had gone.

Foremost in his mind, as he laid on his handfuls of moist clay, was a symbol of dictatorial power. The bronze casting would be much the largest ever attempted; anyone who knew and heard said it was impossible. But the word impossible proved nothing; Leonardo worked out the figures and plans for the

furnaces. Meanwhile he moulded contours of planes and surfaces, and the heroic symbol finally escaped from the sodden mass. From the tip of the out-swung baton, down and across to the planted hoof, man and animal were bound together in a sweeping rhythm. The long, lean head of the steed took on a touch of wildness. The slender curve of the man's body followed the movement of the beast's neck, and the gesture of the man was a command. The portrait of Francesco Sforza became a vision of an imperious spirit.

Marco and the rest of his students now helped Leonardo to mix the plaster, smear it on the model, chip it off when it had dried, fit and bind the pieces together, pour the plaster into the fitted mould, break it off and take out the hardened cast, and finally rub it down. Even little Giacomo helped, to the confusion of the others. He kept jumping into the pile of sand; he smeared the tallow on his face; he spilled the turpentine. They could not drive him away because if one of them raised his hand to him he ran to Master Leonardo, who patted and consoled him with a coin. When the imp eventually left they all felt happier except one who found that his silver pencil had gone.

The wedding guests arrived daily. Through every gate, every day, there swept into the city carriages distinguished by coats of arms or other awesome insignia, and armed guards. These were the ruling families of Europe with their ambassadors, spies, and scandalmongers. They drove into the courtyard of the castle, dismounted, and disappeared from the sight of the man in the street; but the lights in the castle glimmered more numerous and later than usual, and the piazzas of the city became gayer.

In the piazza of the cathedral a sort of low Roman arch had been erected, and one day a wagon, creaking through the city street, drew up to it. A crew of men came along with rope and tackle and, directed by Master Leonardo, they unloaded the freight and hoisted it on top of the arch. When they uncovered it, a roar arose from the crowd in the piazza, spread through the city and, as fast as courier could travel, re-echoed through the courts of Europe. The gleaming figure of the man on a horse stood against the sky.

Leonardo caught the drift of opinion as it floated by. He always listened politely to comments on his work, though they were seldom worth listening to. There was the pompous man, who said:

"Resembles the work of Donatello . . . greater than any Roman sculpture . . . inspired by Verrocchio's Colleoni . . . a splendid example of the handling of masses . . . Praxiteles, you know."

There was the man who had nothing to say but liked to hear his own voice, and exclaimed:

"Very interesting. Most interesting. I get from it a feeling of, ah, space and, mark you, light. Yes, I would go so far as to say, indeed, yes."

The plain man said: "It must have taken tons of plaster, it's so big. My father says it's a speaking likeness of the Duke except that his nose was bigger and he was stouter."

Leonardo did not mind. The talk overlooked him entirely, and he felt a bit lonely. But talk was usually like that. He wished Verrocchio, or the sculptor of the man on a horse at Pavia, could see his work. They could estimate the thing he had tried to do, and whether he had done it. He himself felt there was still a good deal to do before casting it in bronze.

Not Ludovico. He was in raptures. It was a daily inspiration to him to go to the piazza and stand looking up at the gleaming 'Man of Force,' his illustrious father. The giant image imparted to his body some of the invincible power. He too was a Sforza; he too was a man on a horse! The ambassadors to his court might have noticed a slight swagger in his gait and some fever in his words. There was good reason; Ludovico Sforza had made another move on his chessboard. The day, the very hour was close when he would proclaim himself Duke of Milan. He could hear the death-rattle in his nephew's throat. He looked round warily. His position was safe in all quarters but one—the French—and the more he studied the board from that aspect the weaker he felt.

"France will be the end of me," he thought frantically. Charles VIII of France had title to Milan and a striking argument in his artillery. The case was desperate. Ludovico felt himself

squeezed between Naples to the south of him and France to the north.

Then in a flash the move came to him: to turn his enemies against each other. It so happened that Charles VIII also had some title to Naples.

And, Sire [Ludovico sent word secretly], I would urge you to assert your right to the Kingdom of Naples, against whom Milan is ready to render you all the assistance in its power.

Charles returned the courtesy with a message of interest and pleasure.

Ludovico felt light-headed with excitement. "With France my ally," he said over and over to himself, "I shall be master of Italy."

No one else was told about his secret understanding with the French King. Only one other seemed to know, and that was the gleaming man on the horse. At first Ludovico was startled to find that out. He was passing the monument, and bade the coachman halt. Groups of people were sauntering round the base. There was nothing unusual in that, and feeling troubled in mind Ludovico raised his eyes to the mould of his father. He became conscious of the people nudging one another, and was just about to order the coachman to drive on when the eye in the giant head winked at him. Ludovico started, but no one else had noticed.

From that day on it was plain that the man on the horse knew. To Ludovico, though to him alone, the figure made signs from time to time. During the months that Charles VIII was preparing to march into Italy, Ludovico would go to the monument and anxiously look at it. The man on the horse was signalling to him, but the signs were enigmatic. He saw the hands that held the reins move imperceptibly; he saw the baton waver; he saw the visage distinctly frown. What did the signs portend? Ludovico dared not consult anyone, and he often retired to his chamber in a state of collapse.

One night, after he lay down, he had a queer sense that someone was in the room. He could have called the guard, but thought it safer to lie quiet and pretend to sleep. A pale in-

candescence passed over him, and he perceived that the flat disc of the moon had stolen into the room. The thud-thud of hoofs broke in, and he heard a voice. He lay with his eyes shut tightly.

"Francesco," the voice said, "is it you? I can't make out; it is so dark here."

"Yes, Bartolommeo, it is I," came the reply. It was the voice of his father. There were three men seated on horseback, but the third man kept silent.

"I was expecting you," said the voice of Bartolommeo Colleoni. "But, my word, I should hardly recognize you. There's something about you that's different."

"It's the pose. Don't you like it?"

There was a snort.

"It's very becoming. Very lofty, and all that. Only you never looked like that."

"What about yourself?" replied the voice of Francesco angrily. "You can't impress me with that heroic attitude. I was always a better man on a horse than you."

"You were, I admit it. Don't get angry. All I meant to say was that these artists have their own ideas. It's a good thing we didn't look so silly in the field, or our men would never have trusted us. But of course Verrocchio, being an artist, never thought of that. Artists idealize one so. Who was your artist?"

"Leonardo da Vinci. I'm to be cast in bronze. It'll take two hundred thousand pounds." The voice was full of pride.

"Good Lord! You always did manage to get the best and the most. I wonder who did this fellow." The voice indicated the silent horseman, but he maintained his silence. "No use asking him. He's a foreigner, Goth or something."

"I know," said the voice of Francesco. "I've seen him at Pavia. But, Bartolommeo, I'm worried. I know my boy Ludovico would like me to have all that bronze, but I don't think he can afford it just now; two hundred thousand pounds of bronze can make a powerful lot of cannon."

"Francesco, you shock me. In your ideal State, can you still think of war? Better take the bronze. Otherwise you'll be excluded from the assembly of noble monuments."

"Oh, I shall, shall I? But Bartolommeo, the poor boy has made a serious mistake. It's not his fault. He has no experience. He's not like us. He was never in a fight. I brought him up differently, gave him the best education money could buy. He understands music and art and the better things of life."

"I remember the lad, a splendid fellow. But what's he done?"

There was a long pause. Then a groan went up, and the voice of Francesco Sforza said: "It's dreadful. He's invited the French army into Italy."

"What? The fool! It's unforgivable! He'll regret it."

"I'm afraid so. You see, he learned his political chess from watching us. Alliances, and playing one power off against the other, and the rest of it."

"Yes, but couldn't the idiot realize that things were different with us? We were professional soldiers. It was good business for us to foment wars: Florence against Pisa, Venice against Milan, Christian against Turk. He surely must know that both you and I worked for Venice against Milan; that when Milan made us a better offer, we changed sides. Didn't you ever tell him how we used to prolong sieges so as not to end the war, and how we used to free our prisoners in order to preserve the enemy?"

"I never did that," said the voice of Francesco coldly.

"Now, don't let the monumental pose affect you!"

"It doesn't matter, Bartolommeo. Of course we agree that no State ought to call in the professional fighters."

Bartolommeo Colleoni chuckled. "Look what happened to the Republic of Milan when she called you in. You did a splendid job there."

"Thanks. Anyone else in my place would have done the same."

There was a silence in which the Gothic horseman seemed to grow in size and advance stealthily. Choking with fear, Ludovico watched him.

"Well, I'm afraid there won't be any monument for Ludovico Sforza."

The Gothic horseman was upon them. Ludovico could stand

it no longer and, with a mighty effort, sprang up, shrieking:
“Father! Father!”

He awoke. His secretary was waiting for him.

“My lord has had a bad dream,” he said. “A courier has just come to inform us that the French force has crossed the border.”

The Betrayal

THE proprietor of the tavern was storming to his clients about the French soldiers. "Vandals! Thieves!" he shouted. They had used his place for target practice, broken every last dish. And then, sirs, when he protested, they had knocked him down. God be thanked, they had left Milan. One could at least breathe again, for in such times that was all one could afford to do, breathe. . . .

At a table in the corner of the room Leonardo was making the most of the proprietor's outburst by sketching some of the poses before him: a man with his head turned to the speaker and a glass in his hand; another with his body bent towards the speaker and his hand shading his eyes as though from something he dared not face. One with his brow knotted with anguish and his hands thrust outward, palms up in a gesture which said: "This is insufferable. Don't you see? Insufferable." His companion, with mouth open as though to say: "How can such things be?" Here was a man blowing on his food. Alongside, a man was whispering into the ear of his friend who, in the act of cutting a loaf of bread, had stopped to listen, holding the knife in one hand and the bread in the other.

Leonardo heard as well as saw them. The events that aroused the people of Milan were those of Ludovico's making—Duke Ludovico now. For just at the time that King Charles of France was being entertained by Ludovico, the young Duke Gian Galeazzo had died—poisoned, the rumour persisted. Meanwhile the presence of the French army in Lombardy had thrown the rest of Italy in a panic. The King of Naples had fled. In Rome, Rodrigo Borgia, the Pope known as Alexander VI, was trying to collect a force to meet the French. Ludovico had with satisfaction turned over two hundred thousand ducats to Charles



STUDY FOR THE HEAD OF JAMES THE ELDER

Lower Left: SKETCH OF THE SFORZA CASTLE, MILAN

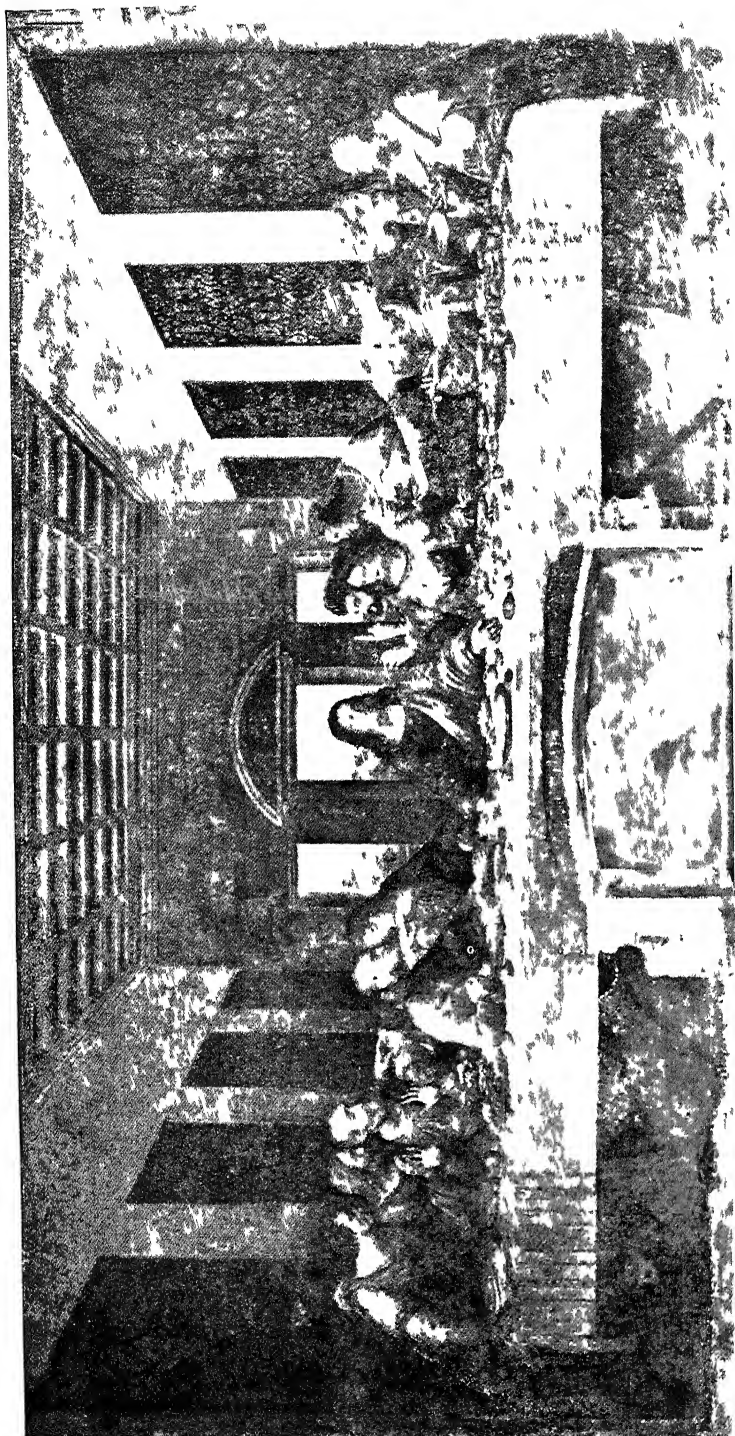


Photo by Anderson

THE LAST SUPPER (1497)

and sent him on his way to Naples, which he took without a blow. King Charles stopped long enough to stage the ceremony of crowning himself King of Naples, and marched upon Rome. At that moment Ludovico thought himself the most powerful Prince in Italy, but in the tavern and in the market-place his subjects were muttering:

"Hundreds of thousands of ducats for Maximilian, for Charles, for the court and its pleasures. And who pays? The taxes on bread and wine are up—and for what?"

Leonardo sympathized with the people. He himself had not been paid anything by Ludovico for the past two years. Never had he been so desperately in need of money. Six people were dependent upon him, and he depended upon Ludovico. He had not the slightest interest in the adventures of the ruling families of Europe, but they had touched him with a heavy hand. What should he do? Should he leave Milan? Where should he go? He was ready to turn anywhere or to anything, when Ludovico had put off the hour of his decision by giving him the commission to paint a Last Supper for the refectory in the convent of Santa Maria delle Grazie.

It was a common subject like the Adoration. Every convent or monastery that could afford it had a Last Supper painted on the wall of its refectory. Leonardo's old friend Perugino had just finished one in a near-by town, and Perugino, of course, did the usual kind. This viewed the event as a sacrament. The Apostles sat quietly at the table in a spirit of mystic communion. Jesus was the central figure, and Judas, his back turned theatrically to the spectator, sat apart from the others.

Leonardo could not accept this version of the drama of the Last Supper any more than he had accepted the common version of the Adoration. He envisioned both events not as rituals but as upheavals in the living soul. In the terse passages in the Gospels dealing with the last supper of Jesus and his disciples he saw shadows of a heroic passion. But the picture was blurred, and the effort to focus it painful. He would not accept the usual theme, the mystic communion, and as yet he could not evoke a theme of his own.

No torment racked him so much as facing the blank wall in

the refectory of Santa Maria delle Grazie. Time after time he lifted his brush to it. But the wall was blank. He saw no picture upon it and he put away his brush. Again he took up his sketch-book and wandered among the stalls of the market-place and into the taverns in pursuit of models. The Abbot of the convent complained that Leonardo was neglecting his work, and Ludovico, meeting him by chance after Mass, reproached him for his neglect.

"I am looking for a Jesus, Sire. For a Judas, the Abbot himself will be satisfactory," said Leonardo with repressed fury.

Unmoved by the goad of men with little taste in art, he went on with his search for the living drama of the Last Supper. In the byways of the city he was able to find models for all the Apostles and, although he had not yet come across a suitable type for Jesus, he was ready to begin. But the wall was still blank for him.

Now as he listened in the tavern to the comments, the lines of a picture began to form on the walls of the refectory. The Duke, the news ran, had made a startling change in his policy. Ludovico Sforza had begun his career by driving from the throne his brother's widow. Later he had stolen it from his nephew. To keep the throne he had infested Italy with a French army. Now he suddenly turned against the French King by forming a league of powers, including Germany, Venice, Naples, Ferrara, to oppose him. Surprised by Ludovico's treachery, Charles had been forced to retreat and barely hacked his way to France and safety.

Leonardo went straight to the refectory and began his work to bring out the picture he perceived buried in the wall. And he turned to the Gospel according to Saint Matthew and read :

And as they sat and did eat, Jesus said, Verily I say unto you, One of you which eateth with me shall betray me.

“ *The Last Supper* ”

IT isn't enough to paint the shapes of men," said Leonardo in his quiet, pleasant voice. "The good artist must also paint their souls. That's the more important thing. He has to choose the right moment and just the right gesture to reveal the soul. It's not easy to do."

Marco saw that for himself. Leonardo stood above him on the scaffolding set up along the wall whose upper half seemed to be removed, disclosing another room. Such was the illusion frescoed upon the surface of the wall. A white table occupied almost the full breadth of the foreground and upon it utensils and articles of diet lay scattered. In the background, three windows framed a misty landscape that dwindled and faded into the horizon. A shadowy light was made to slant across this room.

Leonardo was engrossed in his sketches of the actors for the scene. Marco had seen them, a varied lot of heads done in red chalk: bearded faces expressing astonishment, protest, grief; men with flowing hair and pleading eyes. Of these, two had for Marco a beauty not of this earth. One was a youth in profile, with full, soft lips parted in a sigh, his eyes big with compassion; Leonardo had marked the sketch: *Philip*. The other, marked *James*, was of a head bowed in profound thought. On the same page, directly under the head, Leonardo had also noted down an incomplete, rough sketch of the Sforza castle. The two studies were thus brought together by chance. But Marco, gazing long at the heavenly face brooding over the little world of men, preferred to think of it as design. He fancied it the symbol of Master Leonardo himself.

"An artist's work would be easy," Leonardo went on, "if he had only to imitate what he sees in Nature. But he does more: he interprets."

He pointed to the wall. "How shall I group thirteen people round that table without seeming to crowd them? What gestures shall each one make to bare his soul? How shall the figure of Jesus be made to dominate? How shall every stroke add to the dramatic effect of Jesus' saying: 'One of you shall betray me'? That's my problem here."

He took a few measurements, then faced Marco. "The artist's mind is like a mirror full of sharp impressions which he tries to control. Some he keeps; some he discards. Everything depends on his control of them. He tries one arrangement of them; he tries another. His struggle with them ends finally when he has made them express the thought in his mind. Or"—he hesitated—"in the mind of Nature. And that is the joy of art."

Marco was not sure he understood. But he did understand that the wall, once blank and without meaning, now had both life and meaning. Perhaps *control* meant that.

"Would you like to know a little about my struggle with the Last Supper?" Leonardo asked, smiling. "Jesus will dominate the picture by being in the centre, all the lines converging in Him. His divine head will be aureoled by the light of the central window. The Twelve Apostles must then be balanced in two groups of six on each side of Him. Each of these groups of six will have to be subdivided into two groups of three. In that way I hope to avoid the danger of crowding the figures. But now I run into another danger. Will not my four groups of three seem disconnected? How shall I connect them? The answer is: through their gestures."

He paused. "The painter of a Last Supper usually marks off Judas by putting him on the opposite side of the table. But to complete my groups of three, I have to put him with the rest. How then shall I distinguish the man of treachery?"

With that he turned again to his work. The light was fading in the room and the faint contours of the figures on the wall were no longer visible. The artist laid down his sketches and brush. He threw a final look at his work and in that look Marco thought he sensed something of despair. Then he sprang down from the platform.

"Come," he said. He had been working since sunrise.

Marco often watched the signs of the artist's struggle with his subject. He had seen the master stare at the wall for hours, with his arms folded. All at once he would take up the brush, and apply a single painful stroke. Even then he might stop, shake his head, and eradicate every trace of that hard-won stroke.

When the work seemed to Leonardo to go very badly he would not touch it for days, nor even come near the church. At such times he would pick up his kit of hammers, files, chisels, and go back to the colossal Francesco. Still hoping that Ludovico would furnish him with the bronze for casting the monument, he kept perfecting the plaster model.

Any morning, as he was shaving the plaster to bring out some sinewy movement in the flank of the horse, he might fling down his tool, go dashing across the piazza towards Santa Maria delle Grazie and into the refectory. Once there he would jump on to the platform, deal the fresco two or three swift brush-strokes, and leave again in a hurry sufficient to knock over the Abbot who cried out that Leonardo was neglecting the *Last Supper*.

“For the artist,” Leonardo warned Marco, “solitude is best. If you want society, find it among your fellow artists. But work alone.”

Yet when the news spread that the celebrated Leonardo could be seen at work in the Church of Santa Maria della Grazie, solitude for him became a forlorn hope. Around the scaffold in the refectory gathered a knot of gentlemen, friars, artists, and cock-sure cranks who shot off their opinions freely, with results fatal to understanding. Leonardo generally kept his back to the public, but occasionally he would stop his work and listen attentively. Marco marvelled at his courtesy, though he himself was proud that his master should be the object of so much wonder and talk. And talk there was.

“Think of it! He has the Apostles in groups of three.”

“I know. And he has put Judas with the others.”

“So I noticed. Did you know that his model for Judas is the Abbot himself?”

“Better yet, his model for Christ is a notorious criminal.”

Such legends sprang up upon the weakest foundations of fact, a pleasant joke or a report that Leonardo had been seen roaming

about the slums of the town. No one could mistake the stately figure in the short red cape and black beret.

Some three years had passed since he had begun to work in Santa Maria delle Grazie. One day the scaffold was taken away and people crowded into the refectory. A solemn hush fell upon the room. Then a moan welled out of a throat there. The mystic drama, elsewhere to be contemplated in peaceful settings, here broke through the solacing dust of fifteen centuries and for the second time embroiled every spectator in its pathos and terror and guilt. To every man present it spoke and said:

Look! It happens in a room like this one you yourself are in. The table and the utensils are indeed the very same you know. Those are the creases of a freshly spread tablecloth, for it is the feast of the Passover. But what has happened? Do you see, something terrible has happened. The Master has dropped His eyes mournfully, and stretching out His arms in forgiveness has said:

"Verily, verily, one of you shall betray me."

The words are spoken simply, but they have thrown the disciples into confusion. On either side of Jesus is a swaying, gesticulating group. Every man is touched and involved. Peter has sprung to his feet; he whispers vehemently to John, who sits at the right hand of Jesus:

"Who? You must know. Tell us who, and let us fight."

In his excitement Peter grabs a knife, lurches against Judas who, thrown forward, knocks over the salt. Judas is a study in fright. In his right fist he clutches a money-bag. Involuntarily he puts out his left hand, as though to ward off a blow.

"Surely," he seems to stammer, "you cannot mean . . . You would not suspect me, by any chance. . . ." His face is drawn, his body tense. He is at bay.

Behind Peter is Andrew who holds up his hands in horror: "Heaven shield us!"

Bartholomew and the younger James bend forward excitedly: "Who is it, Master? Say who."

On the left of Jesus, the elder James throws out his arms, and his head sinks in despair. Over his shoulder Thomas raises a forefinger like a question-mark.

"Let us consider," he speculates. "One, you say. . . ."

“ THE LAST SUPPER ”

Philip bends forward: “ Is it I, Lord? ” he pleads passionately. “ Thou knowest it is not I. Look Thou but into my heart.”

At the far end of the table the patriarch Simon stretches forth his hands in protest: “ What can this mean? I do not understand it at all.”

Matthew and Thaddeus turn to him with the utmost excitement. Matthew appeals to him to speak to the Master. “ Speak,” urges Thaddeus. “ We will know who is the arch-fiend among us.”

And among the spectators many a man searched his conscience, asking, like Philip: “ Is it I, Lord? ” Others, like Peter, searched the conscience of their neighbours.

“ Leonardo is right,” murmured the humble and devout hearts. “ Judas, too, is close to the Lord, like all his flock. Not apart.”

The Duke was deeply moved by the work. His Duchess had died and he went often to Mass at Santa Maria delle Grazie. Death frightened him, especially the death of Charles VIII of France. But he felt no alarm for himself.

“ Is not Judas a sinister figure? ” he commented, gazing with pleasure on the greatest painting in the world, and his. “ Leonardo,” he said, “ you must paint my portrait on the wall opposite the *Last Supper*. Mine and—” his voice broke “—that of my poor Beatrice.”

The Quest

LEONARDO at last slipped away from the admiring throngs and climbed up to his studio at the top of the old castle. He was tired. Not physically—in body he was hale enough—but he was weary from the tedium of the brush and chisel. It was a brutal waste of time to fuss with paints and to spend day after day hacking into a pile of plaster. He had designed a machine for grinding colours out of solid pigments, and his apprentice Giulio had built it for him, but alone it saved him little labour. Unless he could have an arsenal of such machines he must abandon the practice of art; it was too mechanical. Moreover, the end of it was unsatisfying: the result of all his labour on the steed and the *Last Supper* was that the Duke crowed and the people gaped and gossiped.

He opened the door that led out upon the roof. Under a shed, just outside the door, stood his flying machine. It had a wooden frame over which was stretched a fabric shaped like the wings of a bat in full flight. He ran his hand over the rod that hung down from the helm of one of the wings and pulled on it: the tips of the wings dipped and folded under. His weariness left him and he went lightly back into the studio.

“At his best,” he thought, “man will do no work that is purely mechanical. He will be free; he will have wings.”

To bring nearer the day of emancipation he had himself invented dozens of machines. He meant now to make them efficient. In the case of his flying machine, the penalty of inefficiency was death—his own death—because one day soon he was to launch it into the air with himself at the controls.

The chief problem for all his machines was power—how a wheel or lever operated at one end could transmit its power to the tool at the other end; how the circular action of a wheel

could be transformed into an up-and-down or any other form of action. It was a problem in transmission. Up to now he had relied upon a few simple devices: levers, and a small pin-wheel meshing with a big cogwheel which drove an axle. Now he asked: How long should the lever be? How big the wheel? What other gear could transmit power?

He plunged into the deep end of the problem and touched bottom with the question: "What is power? Power, force. What do we mean?"

The question floated up to the surface of things, where it darted about. "An arrow sails through the air; a man gets out of his seat; a fish wriggles through the water; a girl skates on the ice; a star falls in the heavens. Are they moved by something we call force? A man lies on his bed; his body exerts pressure. Is that, too, an evidence of force?"

He was puzzled. "If bodily mass exerts pressure, is it not a force? And does not force act as though it has bodily mass?"

"Words, words," he thought impatiently. "I want to know a definite thing: If I shoot an arrow one hundred yards, will a bow twice the size and power shoot it two hundred yards? If one unit of force moves a weight at a certain speed, will half that force move the weight at half the speed? Two balls of different weights strike each other at right angles: what course will each take? If I drop two weights . . .? But enough of words."

When his pupil, Giulio the mechanic, came in Leonardo said: "Giulio, I want your help. Will you make me two metal tubes? I shall also want several crossbows and arrows of different sizes."

He went up to the tower of the castle, and out of the window dropped several iron weights to the ground below, where Giulio was stationed. Giulio marked the spots struck by the falling weights, and noted the time when each ball struck. As a check, Leonardo repeated the experiment. Later, when he sat down to study his data on falling bodies, he was assailed by all sorts of questions. Of one thing, however, he was convinced: that gravity was an accelerating force. After he had allowed for the resistance of the air, he concluded that with each instant of time the falling body gained speed, and in definite amounts. He

needed to work out the rule mathematically—for only in the precise language of mathematics was such a discovery of use.

While he was carrying on his search for the laws of motion he kept his flying machine foremost in his mind. The resistance of the air, for instance, had to be reckoned with. Birds understood the resistance of air as fish understood the resistance of water. Man had made craft to navigate the one sea and could make craft to navigate the other. Fish—did he say fish? He remembered seeing a mullet flash through the dense water like an arrow through the thin air.

“The shape of the fish helps to overcome the resistance there,” he thought. “Broad in front and tapering off behind. The stream flows without hindrance along the body.” The perfect flying machine would be so shaped that the air did not hinder it but flowed round it like water round the mullet.

He noticed one day that when he let things drop from the roof or down metal tubes, they did not tumble haphazard. Whether of wood or stone or metal, round or square or oblong, each thing fell as though dragged by a string tied to it, and tied always to the same point. Every object had such a point or centre of gravity upon which depended its equilibrium. When the object fell, it was because this point in it, heavier than any other, was lower than any other and, having no support under it, dragged the object down. How could he locate the centre of gravity of an object? he asked.

“A man lifting a heavy weight with one hand extends the other,” he reasoned. “He balances himself, we say. A man slipping on the ice throws out both arms to restore his balance. When he falls, it is because his centre of gravity is outside the support of its base, his feet. If, then, I could locate the centre of gravity of a body, I could provide the precise support for it.”

He felt that he was on the track of an important idea, especially for a flier. Day by day it led him deeper into the unexplored areas of science—how deep he did not know himself until Luca Pacioli came and struggled along with him.

A knock on the door announced Luca Pacioli, and there before Leonardo he stood in his friar's frock. The friar's frock was often the sign of the scholar who, having no other means of livelihood,

had taken shelter in the Church. Such was the case with Fra Luca, who had come to Milan at the invitation of Ludovico. He hailed from Venice, where, as a mathematician, he had made himself useful to the merchants by inventing the system known as double-entry book-keeping. He needed no introduction to Leonardo, who in Pavia had read Fra Luca's newest book on algebra. For his part, the friar had come to pay his respects to the famous Leonardo and request the master to illustrate a treatise of his on geometry. Leonardo was delighted. For years he had wished to devote some time to the pursuit of mathematics. This was his chance.

On his work table stood a balance, an upright post with a lever arm on each side.

"Fra Luca," he said, "I have hung a ten-pound weight on this lever four feet from the fulcrum. To balance it, at what point of the opposite arm must I hang this six-pound weight?"

The friar smiled incredulously. He had gone to meet a celebrated artist. Was he in the wrong house?

There was also on the table a pulley system, a zigzag of cords passing over little wheels, and Leonardo pointed to it.

"I want to know how many of these pulleys together will make a two-pound weight lift a ten-pound weight. Can we find a rule?"

The friar shook his head. A pretty problem indeed; but not mathematics. At least he had never met its like among mathematicians.

"True," said Leonardo. "This is mechanics. But mechanics is the fruit of mathematics."

He took a long board and propped up the end of it so that it formed the hypotenuse of a triangle. He picked up an iron ball and set it at the top of the inclined board. Then he let go and, as the ball rolled down faster and faster, he turned to the friar with the remark:

"The angle of that incline, the weight of that ball—if we vary either one we vary the result. True? Can we not work out some rule about it? Of course there is a certain amount of friction to consider. But I have discovered how to reduce the friction: I rub grease over the surfaces."

At last the friar began to see. Leonardo was digging beneath the crust of experience for no smaller treasure than laws which moved all creation, men and sparrows, the falling leaf and the timeless star. The board, the iron weights, the twisted cord, and all the other homely things on his table were his guides to the nuggets of exact truth. His 'experiments' were the questions he put to them.

"Come, Fra Luca," urged Leonardo. "I shall draw the illustrations for your book, and we shall spend pleasant evenings together. I know now that in this life we can rely on no truth but your mathematical one. He who would think well must be able to put his thoughts into its language. We shall work together."

So began a friendship between a friar and one whom wagging tongues called a heretic. It was a fine friendship, for it never suffered from bitterness or boredom. The two friends agreed heartily that the sum of all the angles in a triangle was equal to two right angles. When they had inscribed a circle in one of their equilateral triangles, of which they had plenty, and the little friar left to go to bed, Leonardo sat up to face the inscribed circle, hardly able to wait for the morning to tell old Luca what he had discovered about the relation between the diameter of the circle and the axis of the triangle. And when he heard, Luca was not jealous of Leonardo. He was in fact happy to hear of the discovery. He had himself found out a few things about the multiplication of roots. Now and again he had bad news, too: he had found a flaw in Leonardo's squaring of the circle. But Leonardo listened amiably. The news did not touch him personally.

The atmosphere round them was rare and invigoratingly cool, and day by day Leonardo hoped that it would shed its sharp white light upon his transmission gear. Those circles on the paper between them might be wheels; those angles might be pivots; those planes might be fabric under wind pressure. By using the language of mathematics one understood those wheels and pivots and wind pressures, and one understood them precisely.

"Ah," says the dreamy artist Leonardo, looking off into the future, "to fly, to ride upon a sea of wind, to defy fate and reach

a bit nearer the stars, to look down through the abyss of space to the dark earth beneath. I can fly——”

“Prove it,” demands Leonardo the mathematician.

The Artist: “I suppose I must. Well, then, wind pressure——”

The Mathematician: “How much? How will you measure it? Come, don’t be so vague.”

The Artist: “—and resistance due to the moisture of the air——”

The Mathematician: “There you go again. We’ll never get anywhere this way. You can’t build a flying machine or any other kind of machine, let alone control it, unless you can measure these phenomena.”

To measure the velocity of the wind, Leonardo enclosed a small paddle-wheel in a box. The wind blew into the box through two round openings which funnelled it over the paddles so that it drove the wheel, the speed of the wheel measuring the pressure of the wind. He designed another instrument to indicate the direction of the wind. Then, to gauge the humidity of the air, he thought of little scales, on one side a pellet of cotton, on the other side a pellet of wax. In dry weather the scales were in balance; but when the air was damp, the cotton absorbed the moisture and tipped the scales. He hung a pendulum in a glass ball: “This,” he thought with satisfaction, “will help me to guide the flying machine by showing me the angle of its inclination in the air.”

Fortified by his friendship with the friar and his growing skill in mathematics, he went ahead with his search for the gear which would put muscle and sinew into his labour-saving machinery and his flying machine. The friar was astonished at the use to which Leonardo was putting the science of mathematics.

“Leonardo,” he said, “what do you mean by these designs? Is this one of those curious plants you collect or is it some new idea in geometry? If they came not from your hand, I should not hesitate to call them idle fancies.”

“They are all of them devices for the transmission of power,” Leonardo answered. “Here is an interesting arrangement. We apply the motive power at this point—which turns this cylinder

—which turns the cylinder touching it—which turns the disc touching it, and so on—all by the power of friction. In almost every other case friction causes a waste of power. I have in fact found a beautiful device to overcome friction, these roller bearings. Look, Giulio has built me a model. . . . It keeps turning, eh? And here is the brake that can stop it instantly. Oh, that? Three cogwheels of different diameters, one above the other, all engaged by the same pin-wheel. Turn the wheel. You see that the speed of each cogwheel is different from the others. It will be a useful little mechanism.”

Fra Luca and Giulio and Marco were mystified by those eccentric puzzles of Leonardo, by the ropes and belts, by the steel joint that could turn in any direction like the joint in a man's shoulder, by all the torsion and mimic shrieking and stuttering of the models. But Leonardo bent over them as intently as a crystal-gazer over his glass.

Noses and Other Plain Matters

THE nose! Marco mio," said Leonardo. "You've given him the wrong nose."

He touched the drawing of the old man five or six times with his red chalk. He stepped back and ran his long, slender fingers through the golden silk of his beard. Then he nodded and pointed to the picture. Marco cried out in amazement. The breath of life was in those nostrils.

"No, no," said Leonardo deprecatingly, "no feat at all. He has a number-ten type of nose, that's all there is to it."

That morning the old man had shuffled in carrying a bag of shells. He had picked them up from among the rocks outside Pavia, he mumbled. Perhaps Master Leonardo would give him a little something for them: Master Leonardo was known to be interested in such things. . . . And when the old man left, Marco had begun his portrait.

"If you want to be able to draw from memory, Marco, you can easily learn to do it. I did it by observing that people's features fall into several classes. Take the nose, for instance. It's either straight or bulbous or aquiline, or thick in the middle with broad tips and a narrow base, and so on for about ten or twelve varieties. These I learned to draw by heart, and now when I see a nose for the first time I think of it by type. You can do the same with the mouth, the chin, the throat, and the rest of the body."

Marco swung his eyes alertly to the door, in ambush: the first nose that dared to come through would be classified.

One loved the master for those clear explanations. He gave one a feeling of confidence in oneself and in the world around. There were teachers who spread out the mysteries of the world and those beyond the world. Not Master Leonardo. He had no patience with mysteries. Master Cardano of Pavia, for in-

stance, used to speak of reading one's fate in the stars. It was frightening to hear the old man, in his skull-cap, hiss through the gaps of his missing teeth about a knocking on the wall one night. "The next day my neighbour breathed his las-s-st." Well, if it had been Master Leonardo, he would have taken his lantern and gone through the house to see about the knocking, found it to be the cat or a rattling window, and then gone back to bed.

Giacomo's nose. Giacomo—or rather Andrea Salai, as the urchin from Pavia now called himself—had a straight nose and he took excellent care of it. The spoiled darling lolled about, filling the air with perfume and coarse laughter. The only reason he ever tried to paint a picture was to show off his purple smock and jewelled fingers. The master was disappointed in him.

"Andrea," he urged, "you ought to study more seriously. In your youth you ought to acquire that which will console you in your old age."

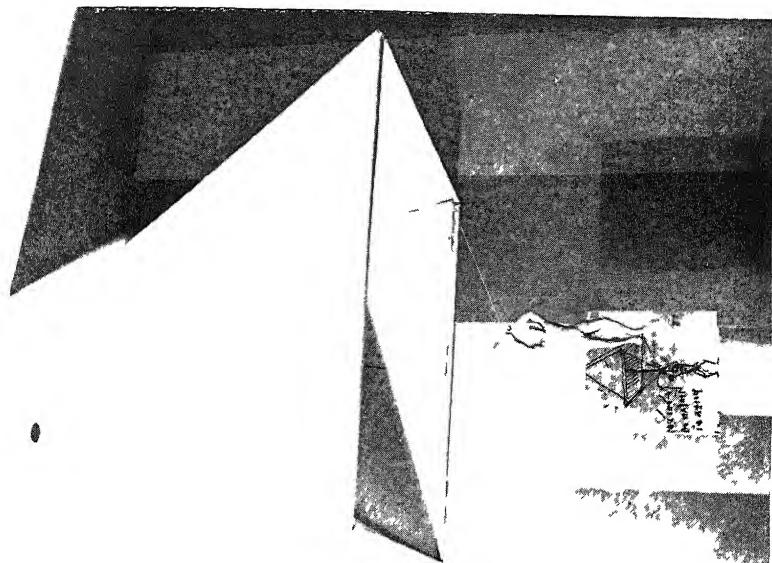
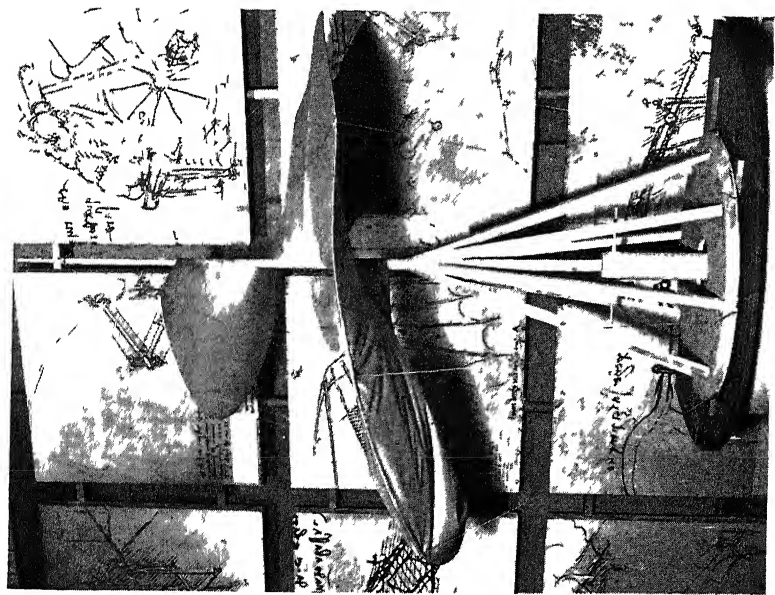
But the only thing that Salai was likely to acquire was what belonged to someone else, and a bellyache from overeating. The master himself ate simply and sparingly. He was always in the pink of condition, straight and muscular.

"Don't frown so," Leonardo would say in his quiet, pleasant way. "You are ruining your health, Andrea. If you want good health, be cheerful."

Another nose poked through the door: Giulio's. Giulio had a monkey's nose, all nostril and nothing else. And how those nostrils quivered when he told the story of Master Leonardo's kindness! Giulio was too poor to pay his tuition fee, and, although Leonardo was himself a poor man, he would not hear of Giulio's leaving, but kept him and taught him for nothing. By trade Giulio was a mechanic, and the master allowed him to work off his debt. So now and then he would make a pair of candlesticks, or a lock, or fire-tongs, or one of the master's strange machines.

Ah, a nose. Fra Luca's. But that was a nose in a class by itself, curved like an angel's wing and just as huge. It had perspective and what the master spoke of as 'atmospheric effect.'

Marco had frequent occasion to admire the ecclesiastical nose



of Fra Luca, for the friar was practically one of the household. It was inspiring to Marco to listen to Leonardo and the friar talking of matters deep and learned. What the friar said was rarely plain, but how clear and marvellous were the answers of Master Leonardo.

"Don't trust me or Fra Luca or anyone else," he seemed to urge. "See for yourself." He respected only those who did 'see' for themselves. Marco felt that even he could 'see' and judge, and the thought gave him courage.

Pointing to the bag of cockle-shells found among the hills, Fra Luca spoke of the wrath of God in sending a deluge which covered the hill-tops with raging seas. The miracle gripped Marco with fear. But the master turned his pale-blue eyes upon the friar. The earth, said Leonardo, was a changing body. In the unrolling of time, here a peak of land slowly pushes its way out of the lapping water, there a peak sinks below it. "These hapless cockles," he said of the shells, "are proof that once the hills round Parma were covered with seas."

Fra Luca, like most people, believed in the influence of the stars on men's lives. Again a clammy feeling overcame Marco. But he shook it off at Leonardo's scornful rebuke. The master had built a long tube fitted with magnifying glasses. Through it of an evening he would gaze at the moon. Now he pushed the instrument to Fra Luca. "Can you see the 'influence' of the stars upon us? Show it to us," he demanded. He often embarrassed his opponent in an argument by such a demand. He himself was all the time measuring and weighing things, and he invented instruments to help him, even one to measure how far he walked.

While Marco lay in ambush for noses, and Salai sulked over a painting, the master was usually busy with his experiments. These were sometimes fascinating to watch, as when he spent an afternoon shooting arrows with the crossbow. After every shot he traced the course of the arrow through the air. Another day, like a magician, he made a flock of wax figures float in the air. The fame of this experiment spread throughout the city, but Leonardo said merely that he had filled the figures with heated air.

Sometimes, however, his experiments were very curious. Once, while Fra Luca discoursed of Aristotle and Euclid, Leonardo went to the kitchen and came back with a sieve partly filled with grains of corn.

"Let us test the truth of that," he said, and proceeded to toss the corn up and down in the sieve. After each toss he held the sieve out for the Friar to see. "The heap is in the shape of a pyramid, you see."

He walked over to the table. "Here we shall have another proof." He struck the table with his fist several times, pausing after each time. A cloud of dust went up.

"*Whew!*" thought Marco. "The housekeeper ought to be more thorough—and Master Leonardo so elegant and well-brushed personally."

"There, sir," said Leonardo. "Pyramids again."

Fra Luca sat on a stool and discoursed of the mysteries of Aristotle. Leonardo, standing at his work table, manipulated his pulleys and levers. Marco could not help reflecting that Fra Luca's talk led only to more talk, while Leonardo's experiments led to the wonder of machines. Not that Leonardo called his machines wonders—he disliked the word—but what else could you call wood and iron and fibre that acted with such purpose? A wagon that moved under its own power by means of gears, springs, and brakes; a timepiece that, by means of toothed wheels and weights, drove a pointer over a disc, indicating the hour and minute of the day; musical fiddles and pipes played by cogs; wings . . . no. Even Marco, to whom Leonardo was all-powerful, distrusted the huge bat on the roof. Wings were only the sign of a tragic desire in the heart of man. Yet there was nothing tragic in the teaching of Leonardo. Just the contrary. Marco loved him for the courage and hope he inspired in one's own two hands.

"Marco," said Leonardo one evening, "will you go into my chamber and fetch me my big cape? Take a torch; it's dark there."

The torch sputtering in his hand, Marco opened the door and stepped into the bedchamber. He was startled by a choking sensation that stopped his breath; then suddenly, with an ex-

plosive puff, the room burst into flame. He turned and ran shrieking into the studio. But he could not make Master Leonardo understand. Marco was frantic, but Leonardo did not move from the spot.

"I know, Marco *mio*," he smiled gently. "Forgive me. It is a trick, not a fire. Those were harmless brandy fumes you ignited. An experiment in fire and fear."

He threw his cape round his shoulders and went out upon the roof, where he kept the monstrous bat.

CHAPTER TWENTY

Flight

ON the roof Leonardo was alone. He passed to the shed where he kept the flying machine, such as it then was. Below its huge bat's wings hung a leather collar, meant for the flier's head as he lay face down. Under the collar ran the framework to support the body. It began in a handle-bar and ended in a sort of stirrups for the feet. A network of leather cords connected the collar, the handle-bar, and the stirrups with vital points of the wings. The flier, lying prone under the wings, was to work them with his neck, hands, and feet.

Leonardo ran his hand doubtfully over the leather fabric of the wings. No, they would not do, he thought. He tugged at one of the stirrups. The question that nightly broke in upon his mathematical sport with Fra Luca was whether in a prone position the flier could generate enough wing power. He feared not, and he came to the decision that the entire machine had to be re-designed.

He looked across the roof-tops towards the palace. The living man on the horse, Ludovico, was again in a fever. Again the French terror had gripped him. Diplomacy had won him nothing but a few years of grace. Charles VIII of France was dead and the new French king, Louis XII, was mobilizing his army. The King had not forgotten that when Charles invaded Italy, at Ludovico's own invitation, Ludovico had treacherously formed a league against him.

Where could the frantic Duke turn for help? Not to his people, who were openly opposing his tax levies. His funds were exhausted. He had not even enough to pay Leonardo two years of back wages, and had offered land instead.

"My dear Leonardo," Ludovico had said to him, "I have made you a gift of a pleasant little farm. The papers are drawn;

the estate is yours. On it you can build yourself a house. I hope you will never leave me."

Well, a farm was better than nothing at all, Leonardo admitted. He could retire to it, and, come Ludovico come Louis, carry on his private work.

"They will not do," he thought, returning to the wings. "The lark's wings are a better model." The lark rose straight into the air; other kinds of birds gained altitude by a spiral or oblique course. Leonardo discovered that on its up stroke the lark extended its feathers so as to leave gaps between them. By this means the bird relieved the pressure upon the lifting wing.

"Shutters, a framework of shutters, round the wings of my bird," he considered. "They could be made to work automatically: on the up stroke, the pressure from above would force them open; on the down stroke, the pressure from below would shut them."

Ludovico, too, was trying to keep afloat by inducing pressure upon France through Germany from above, and through Venice or Rome from below. Nevertheless he was rapidly losing his equilibrium. Unless he recovered soon he would crash.

Leonardo's own test was at hand. Not much longer would he be satisfied to fly pasteboard models with quill joints and wire springs. One day soon he would haul the re-designed aircraft to the edge of a lake. Not like a bat, but like a huge dragonfly, would he reshape it. For the great test he had invented a life-preserver to strap round his body; if he crashed into the water, he would live to calculate his mistake and re-design the flying machine. Ludovico had no such safety device as the air cushion to save himself from disaster.

He peered down into the streets of the city. A party of young men were singing lustily of moonlight and dark eyes. A mother was calling to her son to fetch her some sticks of wood.

"May God send you a quick recovery. Blessings, my daughter," said a man in a cowl as he emerged from a doorway. A horse thud-thudded along the road.

What would they say, these good people, if suddenly they saw a man floating in the air, hanging below an air tent? The

song would turn to silence, the mother scream to her son to hide, the priest cross himself, and the horse stampede. Leonardo intended to build the tent. His experiments with air pressure showed that if a man hung on to a linen tent with a base about twenty feet square, he could hurl himself down from any height and float gently to earth on his toes. What would they say if the floating man were the artist Leonardo?

A soft flutter and flap went past his ear. He caught the bare shadow of a kestrel as it faded away in flight. He followed it as he might follow a song outside his window, humming and tapping with his foot. He took the wedge of the wind against his own sides. A tremor ran through his body as though he had leaped into space where he hung, an imaginary wing curved round the wedge. With both wings extended, he would be safe on a buoyant cushion of air. He would lift his rudder tail and take a shallow dive under the wind, beating his oar wings vigorously. He could feel the rush of the stream over his head. Safety would now lie in speed, and when he had gained enough speed he would lower his rudder tail and feathered elbows. By lifting the shoulders of his wings he would rise above the winds. For a while he would climb, picking his way among the less congested pathways of the air. More and more slowly he would climb. At length a sudden column of air would overturn him, if he did not swiftly lower the shoulders of his wings and dive under the wind, head down and rudder tail above it. Nearing ground he would lower his rudder tail, spread it wide, and stroke short with his wings. His speed at last checked, he could alight.

Yes, he understood birds—not as a bird-fancier, though that was the opinion of him held in the street—but rather as an engineer. The bird controlled wind pressure. It applied this pressure to its changing centre of gravity. It was a machine working mathematically. His own bird should be that.

He had worked out the rules of manoeuvring the machine. He would always keep above the clouds so as not to dampen the wings or be caught in the squalls of the mountain passes; he would fly so high that if he overturned he would have enough altitude to right the machine. He knew what to do if the wing or tail were too far above or below the wind: what to do in

every contingency. He had built the bird so that every part of it could be controlled by the flier.

Again he considered his machine. "No," he decided. "The flier must be in an upright position. It would be awkward for him to lie on his face."

If that were the only trouble with the machine, he could redesign it at once and be ready for a trial flight over Lake Como before the quarrel between Ludovico and Louis XII of France became so noisy as to disturb him. But the chief trouble with his flying machine at this point was that it lacked lifting power.

"The wings must be made to work faster," he said to himself as he went back to his work-table. To the rumour of war he shut his ears.

Fra Luca rushed in one late summer day in 1499. "The French have crossed the border," he announced. "The Duke has sent an army to meet them."

"Indeed," returned Leonardo, without looking up. "Here's a problem for you, Fra Luca. A weight falls two hundred fathoms. How much quicker does it fall the second hundred fathoms than the first? Tell me that if you can. The laws of gravity depend upon it." He turned back to his notes. "The Duke seems to be in a tight fix," he said coldly.

About two months later the news came out that the Duke's army had betrayed him and the French were moving towards Milan. The Duke was bitter. He spoke of ingratitude, of treachery. He pressed his hand to his heart and said to the people: "My people, I count upon you in my hour of trial. Defend your country against the barbarians."

He, Ludovico Sforza, had always been their devoted servant, he said tearfully. If his rule had ever seemed harsh, or taxes excessive, let them remember that it had been the fault of the enemies of his people.

The people listened with the silent, hard faces of those who remember too well. Ludovico made a last appeal to the general hired to command his fortress, and then fled the country.

Fra Luca announced the Duke's flight to Leonardo.

"So the Duke has lost his State. And the French King is

coming," Leonardo mused. "Well, it's a case of the rat dodging the weasel."

In the streets the people were divided between those who sang:

"Now the Moor pays the piper,
Tum-te-diddle, tum-te-dee,
 Thou knowest well, thou swan of Sforza,
 That the dance began through thee,"

and those who sang:

"It serves you right. Gold was your lure.
 Now everyone cries 'Death to the Moor!'"

"The French! The French!" said Marco as he dashed in upon Master Leonardo one day.

"Bring that coil of steel wire in the corner, Marco," said Leonardo.

He was working on a new model, the second since the bat type. In the first the flier stood upright in a basket-shaped car. Above the car two pairs of wings curled helically, twelve feet high and sixty wide. The flier worked the wings by means of cords running over pulley wheels. The car rested on short ladders that could be drawn up after the take-off. This design, though better than the bat model, did not overcome the chief obstacle: that human muscle alone could not generate enough lifting power.

Absently he picked up a ruler and began twirling it in the air. Steel wire would make a better spring than ox-horn, he was thinking.

Something nudged him at the wrist. The thin, flat blade of the ruler was tugging at it. Of course. If the blade were large enough, and twirled swiftly enough, it could tear his arm out of its socket—or propel him over the moon.

Outside his window the uproar had been mounting until it became impossible to disregard it. Not that there was fighting. Ludovico's hired general had got his price from the French and opened the gates of the city to them. The people, happy to get rid of the Sforzas, had welcomed the French quite hospitably. But soldiers were by trade marauders. If they could not do battle,

they could brawl and loot. They had weapons and were bound to find targets if only in the glasses of a wine shop. If the shop-keeper protested, so much the more fun to knock him down.

Leonardo's armour of indifference to the social uproar was pierced. He pushed his work aside.

"We cannot stay here," he said to Fra Luca gloomily.

"I have been waiting for you to say that," the friar replied.

"Where can we go?"

"To Venice, my home. To Florence. You will be welcome anywhere. For a scholar the stars shine everywhere."

Leonardo was silent. He had not thought of Florence for seventeen years. His father and half-brothers still lived there. At Vinci he had an uncle of whom he used to be fond. His old master Verrocchio had died in Venice just as he had completed his monument of Bartolommeo Colleoni. Lorenzo de' Medici was dead, too. And Sandro Botticelli, what had become of him? One might stroll again along the Arno, push among the crowd round the public palace or the Cathedral. One might wander among the bird-sellers' stalls and come across the ghost of a youth from Vinci.

For a moment the backward glance unsteadied him. For a moment only. He shook his head. "No," he said, "Louis or Ludovico, I care not, so he will let me do my work. If the King will let me keep my farm, I shall stay."

He would let nothing side-track him from exploring his new idea. Now he foresaw his flying machine as a horizontal plane, equipped with a screw propeller. The power for the driving shaft of the propeller could be stored in huge steel springs, and he had in mind the very mechanism to control them. First he began to work on a pasteboard model of the propeller-type craft. He had not advanced very far when Marco rushed into the studio, pale and sobbing with rage.

"O Master Leonardo, the steed! They are destroying the steed."

Leonardo bounded out. Too late. The statue had been mutilated before he could save it. The symbol of Sforza power had crumbled like the power itself. The foreleg that had cost him precious weeks of thought and of physical labour lay on the

pedestal, broken by the arrows of the King's hired ruffians. The delicate modelling of the head was chipped and gashed. The arm of the rider that had swept out with the sweep of his own spirit had been torn away, exposing the steel rod of its armature. Leonardo felt his own body torn and bleeding.

He hurried to the Santa Maria delle Grazie. There were no soldiers in the church. He went to the refectory. His foreboding eye swept the wall of the *Last Supper* from the head of Simon to the feet of Bartholomew, passing the pleading face of Thomas and the guilty profile of Judas. He went nearer. The painted light bathed the head and shoulders of Jesus and his hands rested upon the table in everlasting appeal.

The picture drama was still unstained by the arrows of Louis' men. Leonardo calmed down. Suddenly a sort of faint shimmer pierced him to the quick. It came from the lower right corner of the picture, by Simon's foot. An instant later he had his eye to it, and in another instant he knew the worst. The picture was doomed! Another part of him killed—not by arrows but by the unseen dampness of the wall. His spirit, which he had hoped would live for ever, was crumbling as surely as the dust of his body.

A monk came into the refectory, but, seeing Master Leonardo with bowed head before the holy *Last Supper*, went out again.

"I have lived in vain."

He had lived forty-seven years. If he were to die on the spot he would leave no more trace of himself than does a summer fly: a pile of unhatched eggs in his notebooks. His machines to liberate the labour slaves, and his new world of planned cities, would go with him to the grave. At the age of forty-seven he was again dependent, as he had been at twenty-seven, upon the whim of a tyrant. Lorenzo de' Medici, Ludovico Sforza, Louis of Orleans—they were all alike, and he was homeless and penniless. . . . O Christ, O Judas.

When he got back to his studio he began to pack his few things.

"You are right," he said to Luca. "We must leave."

The news reached him that King Louis had spoken of him. On a tour of inspection of the conquered city, the King had

gone to see the *Last Supper*. His Majesty was a skinny little man with thick lips and eyes that seemed to pop out of his head as he stared at Leonardo's painting.

"Extraordinary," he said. "There is nothing like it in all France." He turned to his secretary. "We want the wall removed and sent back to our palace. Can it be done?"

"Impossible, Sire. But the painter himself is here. He is, we are told, a famous engineer."

"A great inventor, Sire."

"A magician, Sire."

"Sire, no greater sculptor ever lived."

"The most learned man in Italy, Sire."

The King held up his finger. "Is he a man or a legend?" he asked. "If a man, I want him."

Not only the King, but the elegant Duke of Valentinois had listened. Leonardo learned that the Duke was Cesare Borgia, the son of Pope Alexander VI. Young, handsome, tricky, well-sired, he was a personage whose favour counted.

"Would it not be better to stay here?" asked Fra Luca anxiously.

Leonardo shook his head. "Have you forgotten that the stars shine everywhere?"

He had recovered from his fit of despair. The future, he felt, was not without hope. His power was at its ripest. By his method of science he could accomplish whatever he undertook. Italians knew of him. Frenchmen knew of him. Some day, he hoped, as he packed the models of his flying machine, all men looking up would become aware of a man with wings.

He embraced Marco. "No, not good-bye," he said. "I shall come back, and we shall be together again."

It was a cold day at the turn of the century when Leonardo, with Fra Luca and Salai, left Milan.

Saints and Sinners

THE new century burst over Italy with a clash of arms and marching men. From the north the invading French swept down towards Naples and Rome. In the east Turkish forces attacked Venice by land and by sea. Within Italy a new man on a horse appeared. It was young Cesare Borgia, the Duke of Valentinois who had stood with Louis XII before the *Last Supper* and made note of the uncanny talents of a certain Leonardo da Vinci. Shortly afterwards he had left Milan, and, with the help of the French army and the money of his father, Pope Alexander VI, led an army into the territory known as the Romagna, where the dukes were falling before his onslaught. The bigger States to the west uneasily watched the growing power of Cesare Borgia.

In the summer of 1500 there were few peaceful spots in Italy, but among them was the monastery of the Servants of Mary in Florence, where Leonardo found himself. After five months of wandering he had come back at last to the city of his youth. His name was a byword there, so that patrons were not long in coming to him, and among them were the Servite monks, as they were called. The monastery wanted an altar-picture, an Annunziata, and the prospect of a refuge from the din and disorders of the world appealed to Leonardo. Together with Fra Luca and Salai he took up his abode within its mossy walls.

But the monks who expected him to turn out the altar-picture in time for display on this or that holiday were disappointed. He had agreed to paint a picture; yet, they complained, there he was month after month engaged with Fra Luca in the study of geometry. Often they saw him writing, or strolling in the garden, his hair flowing over his massive head, a reddish beard curling down from his face, while the months glided past.

Occasionally the monks saw in his hand a pen-and-ink sketch, or a study in red or black chalk. But no altar-picture.

Leonardo was aware of his patrons' grumbling. All his life his patrons had grumbled. "Why," they demanded, one after another, "it's already a month, six months, a year, and still no sign of the picture we ordered." It was no use saying to the monks: "You are mistaken. Your altar-picture is on its way. The idea for it is hatching at the bottom of my mind. It deals with Saint Anne, the mother of Mary. Look, here are some pen-and-ink studies of heads, here some chalk studies of drapery. And that one, which seems like idle twirling of the pen, is a study of plaits of hair."

At the same time that the Saint Anne picture was ripening in one corner of his mind, he was also writing up his notes dealing with flight. The garden of the monastery was a delightful spot and he never felt a more heavenly peace than when he wrote:

I have divided the treatise on Birds into four parts. The first one deals with flight by the beating of wings; the second of flight without the beating of wings and by the help of the wind; the third of flight in general, covering birds, bats, insects, and so on; the last of the mechanics of such motion.

Written in his secret scrawl, running from the right to the left side of the page, his notes, he found, ranged over the entire panorama of Nature. A thought on flight lay side by side with one on human anatomy. One page spoke symphonically of stars, of trees, of rivers. On another, his mind had leaped from an architect's dream of a dome in the upper part of the page to an invention of a musical instrument in the lower. Sifting the notes he came across the remark that:

When the bird wishes to rise by beating its wings it raises its shoulders and beats the tips of its wings towards itself, and so condenses the air between the points of its wings and the breast of the bird, and the pressure from this air raises the bird.

He added the page to the growing pile on flight. The pile grew daily. He pushed it to one side, however, when he felt the picture for Saint Anne and the Virgin suddenly glow in his mind.

And now the grumbling in the Servite fraternity turned to smiles. Leonardo showed them the preliminary cartoon done with black chalk. In it the Virgin is holding the Babe in her lap. On her right side sits the sainted Anne, her eyes fixed mysteriously on the Virgin, her left forefinger pointing upward. Beneath the lifted hand, his elbow resting on her knee, is the Baptist child John. John's eyes are fixed upon the Babe, who raises two fingers in blessing over him.

The two mothers had always been in Leonardo's heart, for as a child he had known two, his natural mother and later his step-mother. The features of one of them eternally haunted him. He tried to express it first in the face of the little angel in Verrocchio's picture of the Baptism. And in the *Virgin of the Rocks* he tried again to bring it out in the angel. In the *Last Supper* it appeared in the face of the apostle James the Elder. It was a face of unearthly beauty, and would for ever haunt him. Now in the *Virgin and Saint Anne* he gave it a new mood. Was it a smile? Or was it some deep source of bliss and pity welling up into the mother's face?

"Ah, my brothers," said the monks, "this truly is the reward of waiting." Never had painter's touch been surer, never had anyone delineated movement in human bodies so skilfully.

But Leonardo looked and frowned. The design did not satisfy his mathematical soul. The mothers' heads were too close together, and too much on a level. The picture was unbalanced; the figure of John tilted it to one side. He began a new design.

Other requests for pictures came to him—from the Court of France, from the Court of Mantua, from well-to-do merchants in Florence. Among these was a certain Francesco del Giocondo, an elderly man who had taken to wife a young, good-looking woman. By way of self-congratulation he wanted her portrait painted by the great Leonardo. Leonardo did not wish to do any more painting than he had to, but there was something about the features of La Gioconda that arrested him. He promised Francesco to do a portrait of his wife.

Beyond the walls of the monastery, Florence now was not the city of his youth. Of his old friends only Botticelli was still there. There was talk of a rising young sculptor, Michelangelo

Buonarotti, but apart from him Leonardo heard of nothing extraordinary in the world of art. The great change in Florence had come by way of politics. While Leonardo had no time for politics, he knew how Florence had wrenched itself free from the grip of the Medici and had established a republic. Back in Milan gossip had filled his ears with the turmoil in Florence and the account of the young reformer Girolamo Savonarola. He heard how Savonarola had come to the cathedral to preach. Week after week the preacher had but one message to deliver: "Italy is doomed. Repent. Italy is corrupt. The Church, the governments, the hearts of men are all corrupt. Repent. The Medici have damped the fire of liberty; the Borgia, Pope Alexander VI, has damped the zeal of religion; and the people are doomed unless they repent and change."

Savonarola was a great orator and, like the prophets of old, had been able to make the people shudder and wail. More and more people had flocked to his sermons, and the hollow-cheeked prophet became their champion against the powerful Princes. The story was told that when Lorenzo de' Medici was dying he called Savonarola to absolve him. "Give back their liberty to the people of Florence," demanded the monk. At this Lorenzo turned his face to the wall, and died without absolution.

Shortly afterwards the people had driven out the Medici and called upon Savonarola to reform their Government. He did not get far in the attempt. He had raised too many powerful enemies in Florence and at last they put him to death. But the Medici were still kept in exile. Florence enjoyed its freedom and the memory of Savonarola, now that he was dead, was an inspiration to hold on to its freedom.

That was why, in 1501, the shadow of Cesare Borgia moving nearer filled them with anxiety. Was Cesare the punishing hand of God in Savonarola's prophecies? Or was he just another brigand who would be appeased when his belly was full? The Government hurriedly sent its young secretary Niccolò Machiavelli to the camp of Cesare Borgia.

Leonardo listened wearily to the tale of men's quarrels. He had seen something of soldiers in Milan. He had seen a fragment of his own life trampled upon by the marching feet, and he was

happy that the walls of the monastery shut out the rumour of war. But, sifting his notes, time and again he came across the design of some war machine or other, until, when he added up his inventions of bombs, guns, cannons, armoured cars, poison gas and mask, and other items in his arsenal of the future, he was shocked at his exuberance in creating tools of destruction. He seized his pen and wrote:

I find a means of offence and defence in order to preserve the chief gift of Nature which is liberty.

His most recent "means to preserve liberty" had been invented in Venice. When he and Fra Luca reached Venice in the spring of 1500 the city was in a panic. The Turkish army had raided Venetian territory, and, though it later retired, was a constant menace. The Turkish navy had moreover defeated the Venetian and was becoming master of the Mediterranean. In the circumstances the Venetian Government saluted Leonardo, not as the illustrious artist, but as the military engineer. The pink marble of Saint Mark's and the haze melting over the sea might have revealed their sweet mysteries to Leonardo, but he had no time for such diversion.

He had immediately set out on a tour of reconnaissance through the valley of the Priut, and along the Piave and the Tagliamento rivers as far as Gorizia. He had hurried back with his report that invasion by the Turks could take place only by way of the Isonzo river. The Venetian infantry posted along the river would find it an easy position to defend. But to make the defence impregnable he recommended that a large dam, controlled by sluices, should be built at Gorizia. If ever the Turks attempted an invasion, they could be checked by opening the sluices of the dam and flooding the terrain. Leonardo drew up the architectural plans for the dam.

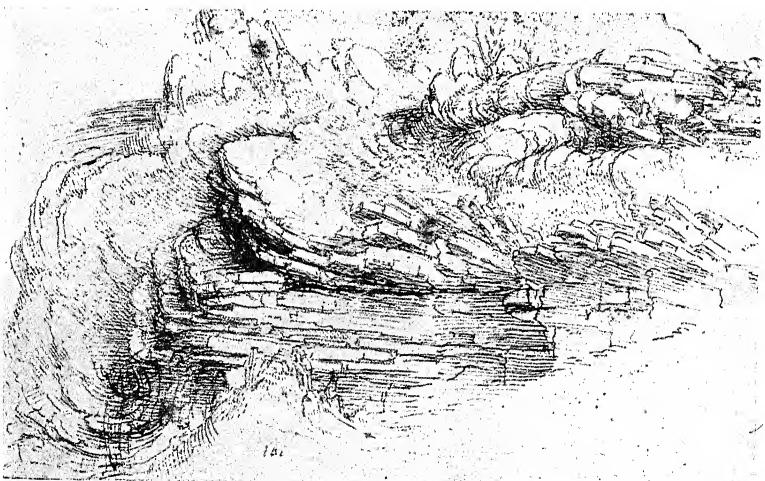
Then he had turned to the problem of defence by sea. The idea of flooding the land for military reasons had sprung to his mind out of his experience in irrigating Ludovico's plantations. Now a diving-suit for undersea fighters sprang to his mind out of a story he had heard from a traveller about the pearl fishers in the Indian Ocean. The pearl fisher went under in a suit made



THE VIRGIN AND SAINT ANNE
(*Second Version*)



LANDSCAPE SHOWING A MOUNTAIN STORM (c. 1503)



STUDY OF STRATIFICATION (c. 1508)

of leather and a helmet with glass windows, and on the surface a companion in a boat co-operated with him. Leonardo disapproved of the leather. The diving-suit he designed was to be made of armour. Weighted with sandbags, the military diver would be dropped into the water. With him he carried a number of skin bladders, which he inflated when he wished to rise to the surface. Leonardo could not decide which of several plans he would adopt to supply his diver with air. He thought of a helmet with a tube reaching up to the surface and kept afloat by a cork attachment. The trouble with that plan was that it would not do for the purpose of military surprise. So he pondered a marvellous device for allowing fighters to move secretly under water and remain there as long as they needed to sink a fleet. The principle on which it was to work was—

Suddenly he had recoiled from the scheme. The news had reached him that Ludovico had raised a force to drive out the army of Louis XII. For a while all had gone well. The people of Milan, who had once welcomed the soldiers of Louis XII, had come to resent their brutality, and they cheered for Ludovico. In vain. . . . He was captured and the end of all his diplomacy was a French prison.

"The Duke has lost his State, his possessions, and his liberty," Leonardo remarked to Fra Luca. "Let us go to Florence."

In the secret pages of his notebook, instead of describing his submersible weapon, he wrote:

I do not divulge my method of remaining under water on account of the evil nature of men who would commit assassinations at the bottom of the seas, by sinking ships together with their crews.

So he had come to Florence and shut out the rumours of war behind the walls of a monastery, and dwelt in peace with his saintly images. At Eastertide, 1501, when he finished the revised cartoon of his altar-piece, the abbot of the monastery declared a festival lasting two days, during which the public should view the picture. Looking at it, the people forgot their anxiety about Cesare Borgia and the wars around them. In that room, at least, they were solaced by the smile of pity and bliss that trembled on the lips of Anne.

The smile is echoed in the faces of Mary and the Babe, and re-echoed in the hearts of all who see it. Leonardo changed the structure of the picture to the lines of a triangle, his favourite form. The apex is the face of Anne and the trembling, enigmatic smile. Mary sits on her lap and, as she yearns towards the Babe, she links the two sides. The Babe playing with the lamb completes the right side. A deep shadowy twilight of hills and sky suffuses the picture.

Leonardo hoped to carry the soft line and mood of the picture into his own life. He would have liked to continue his studies in geometry with Fra Luca, and his book on flight, but his funds were again running low.

The movement ought always to be above the clouds [he wrote], so that the wings may not get wet, also so as to escape the danger of gusts and eddies of winds among the mountain defiles. And if, moreover, the machine should be overturned, you will have plenty of time to turn it back again.

Regretfully he laid aside his notes and with a sigh took up his drawing-pen. Some of his numerous commissions he turned over to Salai or another assistant, himself just sketching in the design. The more important he did entirely with his own hand—the unfinished portrait of Isabella d’Este, Duchess of Mantua, for instance, which he had begun in Mantua on his way to Venice. He also did a little Madonna and Child for the French King’s secretary. Then, just as he was preparing to begin work on the portrait of La Gioconda, a startling summons took the brush out of his hand. Leonardo wanted peace, but the man who now applied for his services was a warlike man. Leonardo wanted a field for his constructive talent, and this man offered it to him. He laid aside the brush and bade good-bye to Fra Luca and Salai.

“I am going to the Romagna,” he said, “to the camp of Cesare Borgia.”

In the Service of Cesare Borgia

LEONARDO held the post of military engineer to Cesare Borgia, but he was also expected to advise Cesare on rebuilding his new kingdom. The petty States that fell before his sword had been indifferently governed and were somewhat decayed. By rebuilding them the invader played for the loyalty of the people. On his way out to Cesare's camp, Leonardo came first to the town of Piombino, then the most western of Cesare's conquests. Here he made a hurried tour and concluded that the most urgent business was to eliminate the swamps round the town. He went over the lie of the land and jotted down a plan of drainage. He indicated a network of ditches leading into two canals, one running round the swamps, the other crossing through them, and both drawing off the water into the sea.

It was spring-time and the road to the camp led through a fragrant countryside. Leonardo made military maps of the terrain. But the sordid business of Cesare often had to wait while the engineer stopped to note one thing or another: the rush of the wind through a field of rye, or the sun dancing on a lake. A horn resounding hoarsely in the hills once diverted him from the road. There was something about the tone of the horn unfamiliar to his ear. When he tracked it down, he discovered that the shepherds had gouged out of the side of the hill huge, hornlike hollows. Against one of these the shepherd would put the small horn he carried, and blow into the hollow. The effect was that of an enormous instrument whose blast summoned not only the strayed sheep but the straying engineer, Leonardo.

The echo of the horn among the hillsides struck a key of thought:

You hear a horn. The sound waves strike a wall: echo. The waves of the echo rebound and strike the opposite wall: re-echo.

And so on back and forth until the tone dies. . . . A beam of light falls upon a mirror. You see it reflected in a second mirror; then back again to the first. And so on from one to the other until the images disappear. . . . You throw a stone into still water; it sets up a series of circular waves, one after another until they die away.

"Does not a single law govern all these phenomena?" he wondered. He felt that it did. But he had a long way to go, many experiments to make, before he could induce Nature to reveal the law. He had begun, however, by finding that the angle of reflexion is equal to the angle of incidence.

As he turned back to the road he made a note to investigate the speed of sound. As usual, he asked a definite question:

If at sixty feet the sound of an echo reaches me in two intervals of time [he wrote], how long will it take to reach me at two hundred feet?

He wondered whether he had put the problem right. In the heavy air of the swamp land, for instance, sounds are louder than in the thin air of the mountains. Well, the problem would have to wait with the rest of the problems scrawled among his notes.

But at the turn of the road it confronted him again, this time ringing out to him from the belfry of a church in Siena. It reminded him of an argument about bells. Once, when he was crossing the piazza in front of the public palace in Florence, he was hailed by a group of men sitting on a bench.

"Leonardo, what do you think?" asked one of the men. "Is the sound of a bell in the bell itself or in the ear?"

"I say it is not in the iron of the bell," said another. "How can it be? If there were no ear to hear the sound, there would be no sound to speak of. Therefore, the sound of the bell really is the ear of the listener."

"And I," said a third man, "hold that the listener would hear no sound if it were not for the iron of the bell. Therefore, the sound is in the iron."

He remembered that he had settled the argument by taking the debaters to the belfry of a near-by church. He had swung the

clapper and, while the tone resounded, had put his hand upon the bell. Thereat the sound ceased, and so did the argument.

A ghostly echo chimed from a neighbouring belfry. He understood that; in his lute-playing days he had plucked the string of one lute and heard a sympathetic chord from another lute lying alongside. People had said: "No, you are mistaken. You are hearing things." Perhaps he was. He laid a wisp of straw on the one string and plucked the other. The wisp had trembled. *Quod erat demonstrandum.*

The chime and its echo rang together in the air. He understood that, too. When you threw two stones into the water, the two series of waves intersected, but passed through each other without interference. Waves were only an up-and-down motion, not sideways. Once he had thrown a wisp of straw into the waters. The waves swept under the straw and it bobbed up and down, but never moved from the spot. The waves of water acted like the waves in the field of rye under the lash of the wind. At the bottom of it all was that law of Nature which he dimly perceived.

When he finally reached the camp of one of Cesare's armies, the problem confronted him again. This time it rumbled angrily at him. The army had its position round the walls of Arezzo. Leonardo was met by Cesare's captain-in-charge, whom he directed in the mixing of explosives and in the setting-up of earthworks for defence. One morning, when Leonardo was sitting in his hut a little way from camp, he heard a sharp rumbling [the flame rolling in the cannon's mouth, he imagined]; then a roar [the flames bursting out into the air]. At his elbow there was a soft, splitting sound, and the crock on the table broke in pieces. The door rattled furiously and the walls shook [the waves of air striking everything in their way]. Cesare's men were attacking Arezzo. Leonardo rose, picked up his notebook and hurried towards the dust and smoke of the battlefield. Along the road, a horse with empty saddle and flapping reins went past him. Farther on, a man was running with bent head and streaming hair. Part of the city was in flames. The roar of cannon had ceased, and he judged that the assault was over. He entered the choking city. The reddish pall that hung over the streets was

pierced by animal-like yells and outcries. He passed by two men bending over a third who lay on the ground, his eyes white, his mouth twitching, his fists grinding into his body.

The captain, when Leonardo found him, was directing the looting of a house.

"Captain," said the engineer-general, "if you find any manuscripts, save them for me."

When he got back to his headquarters, he began a fresh sheet in his notebook, under the title: *How to represent a Battle*. When he finished writing the rest of camp was asleep.

The next morning he left for Urbino, now fallen into the hands of Cesare Borgia. The Duke of Urbino had stocked a fine library, but by the time Leonardo arrived Cesare had removed the library. The only thing of interest for Leonardo was a dovecote. Watching the birds, he was able to confirm what he had once written in his notes on flight:

All birds that fly in spurts rise high by beating their wings. They rest as they descend. . . . The slanting descent of birds against the wind will always be made beneath the wind.

The poor Duke of Urbino, he heard, had taken flight in his nightshirt.

Now Leonardo proceeded to the cities on the Adriatic coast. In his pocket he carried a document, signed by Cesare Borgia, calling him "the excellent and most beloved servant, Architect and Engineer-General Leonardo da Vinci." Everybody subject to Cesare was instructed to allow Leonardo and his assistants free access anywhere. He was to be given everything he asked for, and all other engineers were to take orders from him. The architect and engineer-general determined to make good use of his power under the document.

At Cesena he found a shabby city and at once proposed to remodel it. He drew plans for a city both efficient and attractive, equipped with a water system, fine public buildings, and a public square, for which he provided a singing fountain. The city was to be connected by a canal with Porto Cesenatico on the coast. The port itself was silting up, and Leonardo went to see what could be done about it.

The September countryside was breezy and sweet, and he lingered a while over the details of the map he made of it. The peasants were busy gathering in their grapes and carting their threshed grain to the mill. One thing only jarred upon Leonardo, and that was the design of their carts. He hated stupidity and here was a prime instance of it: a cart with small fore wheels and big hind wheels which threw the weight forward and impeded the motion.

Nor were the peasants very intelligent in their flour-milling, he observed. As he went along he turned over in his mind the sort of mill he would build for them. The most modern type would be run by water-power, of course. But suddenly his hat blew off and a new thing came to him: a windmill. Sails attached to a revolving roof; driving shaft; cogwheel; mill-stones. For brakes, a semicircular band of wood into which the cogwheel was jammed. No one had ever seen its like before. So much the better.

The engineer-general strode briskly down to the beach of Porto Cesenatico to have a look at the trouble there. Pencil in hand, he noted the extent of the silting process. To reclaim the harbour he would have to dredge it; and, to begin with, design the machinery for the job. After that he would put up proper defences against future silting. It exhilarated him to think that he could put the sea under control by even a little. He liked to think that he could take into his hands the majestic sweep of the waters and the wild spill of the tides.

The sea slid and foamed at his feet. He picked up a piece of driftwood and outlined in the sand the tongues and moving triangles of its wake. Here and there the beach was pitted and he could see the foam churning rubble. He poked a stick into a blob of jelly which a moment before had not been there. When he finally left the beach he carried with him a soggy branch tossed up by the tide, and the vision of a moment in the cosmic work of wind and water.

He had had such moments before. When designing canals and dams for Ludovico he had had to calculate the power and pathways of the stream. He had observed the current sweep off a grain of soil here and drop it there. Like breath the shifting

grain escaped the eye, and like breath changed the world. On his excursions into the mountains north of Milan he had now and again been startled by the steep fall of a stone or a puff of crumbling earth. Such were the grain events which in a thousand years changed the features of the world, and created the hills and the valleys.

He gazed upon an ocean of time. "Once," he hazarded, "the whole earth may have been under water. If the water withdrew here or evaporated there, it left a mud pile. The mud dried through drainage, hardened, and became layers of rock. Meanwhile the draining water cut a channel for itself, deeper and deeper, moulding a landscape of crag and valley." He took this view of creation all the more readily now that he himself was about to remould the shore line at Porto Cesenatico.

But the story of the earth fascinated Leonardo beyond the interest of the present moment. Beyond the sea of these shores were other seas and other shores. Only a few years before Christopher Columbus had discovered a new world. Sonorous place-names rang in Leonardo's ear: the Black Sea; the Caspian; the river Don; the Indian Ocean; the Straits of Cadiz; Cilicia; the island of Cyprus; Africa. He would understand the story of the earth only if he knew how great the rise and fall of their tides, the course of the rivers, by what means the sea cut its straits through the land. And so musing he lost himself in a far horizon upon which Cesare Borgia and his business were only a speck.

But the speck of the present moment suddenly loomed towards him, blotting out his whole horizon. Upon his ears fell the sounds of a battle followed by the signal for retreat. When Leonardo shook off his mood of speculation upon the new science of earth history he was to begin, he found himself at Imola, where Cesare Borgia had pitched his camp.

Cesare had met with a setback. His own allies had suddenly fallen upon him, defeated him, and driven him and his small force to take cover behind the walls of Imola. There he was at bay. Another assault and it would be all up with him. And his enemies were crouching for the final spring.

Leonardo was not concerned with the outcome. It was a silly business and he simply bided his time in Imola. Now and then

he was summoned to confer with Cesare, a sharp-faced, bearded young man with cunning, dark eyes. Most of the time Leonardo was preoccupied with his book on flight or his plans for building the canal and the harbour. He still expected to carry out the plans, for the young man with the forked beard assured him that soon he would regain the upper hand. The French King was sending him reinforcements, he said. Moreover, his own force was growing through recruits from among the people.

It was no idle boast. Just as suddenly as his enemies had sprung up, so one day they were no more. When Leonardo heard the story, his blood froze. Cesare Borgia, grown strong by French reinforcement, had offered an honourable truce to his enemies. To discuss the terms of the truce they had arranged a meeting in a neutral castle. The troops were withdrawn, and with only a small bodyguard Cesare Borgia had gone to meet the few captains opposed to him. Once inside the castle, he had lured them into a room where his men hid in ambush. Shortly afterwards he rode back to his camp. The others never came out.

It was not the first time Cesare had won by treachery rather than by the drawn sword. He prided himself on his skilful use of poison and treachery. Under cover of night and a smile he had often, with only a stroke of the dagger, rid himself of a rival. He took the shortest way to success—and, being success, it was good to him and admirable to some others.

Leonardo shrank from the mask of Cesare Borgia. He had in his time dissected corpses, many of them. If he felt anything after a night spent with the dead it was only a sombre joy in contemplating the stern beauty of Nature's dominion. But man's wilfulness made him sick with disgust. Gone was the rapture of yesterday, when he had beheld, as under a flash of lightning, the law dominating waves of sound and water and the lightning itself.

The cool wind of the sea had swept through him and exalted him with a view of the long horizons of time that made the earth. Now the bitterness of the moment stung him like a sandfly. The peace and mirrorlike beauty of Nature lay shattered at his feet. He was alone, and his loneliness hurt. He searched the faces that mingled daily in the camp of Cesare Borgia and on

one face his eyes rested long. It was small, with thin lips and light, staring eyes. No, he was not alone, for he looked into the eyes of another lonely man.

The man was Niccolò Machiavelli, ambassador from Florence to Cesare Borgia. Machiavelli was a man in his early thirties, clean-shaven, with close-cropped black hair and a nose like a bird's beak. There was something indeed birdlike in the quick turn of his head.

"*Cesare or Nothing*," murmured Niccolò Machiavelli, reading the legend sewn on the pennant flying from Cesare Borgia's tent. He looked at Leonardo, "What dash! What daring!" he remarked.

"O monster!" exclaimed Leonardo.

The envoy tightened his cloak more snugly round his thin frame. "Ah, Master Leonardo, I would give a great deal to see the sketch you have made of the Duke."

Leonardo did not answer. From under heavy brows he took in the Duke's tent, flaunting its gambler's stakes of: *Cesare or Nothing*.

"Surely you have made a sketch of him," persisted Machiavelli. "You who take everything into account—even monsters," he added slyly. His voice was high-pitched, and too fragile for the burden of thought it carried. "Have you noticed his eyes, Master? They might be the eyes of a fox."

"Do not malign the fox. It does little harm."

"Harm?" The envoy faced Leonardo. "Whom has Cesare harmed?" he demanded. "He is no worse than others in his place. He is only more brilliant."

"More treacherous, perhaps."

Machiavelli impatiently flicked the air with his hand, as though he were waving aside the objection. "Because he has chased a lot of petty tyrants out of the Romagna? The people are well rid of them."

"He was honour-bound by a truce, yet he murdered the generals who had come to parley with him."

Machiavelli sniggered. "A beautiful piece of strategy. Look you: to a wise prince like Cesare Borgia men are tools to be thrown aside when they are no longer useful."

Leonardo looked in astonishment at the thin, scholarly man with the fierce grey eyes. Machiavelli's smooth cheeks were flushed and his voice was shrill. He gesticulated constantly with one hand, with the other pressing his threadbare cloak to his body.

"You do not understand," he pleaded. "You are an artist. You do not understand politics. Our country is being torn to pieces by the aggression of the French, the Spaniards, the Turks. Our own people are at one another's throats. Is this a time for kindness and scruples?"

Leonardo replied: "I understand the marvel of every human body, and I say that he who does not value life does not deserve it."

Machiavelli's mouth became a straight line as he said spitefully: "Yet you yourself plan war machines."

Leonardo shut his eyes in pain. "True," he confessed. "But I hoped they would be used only in preserving our liberties."

"Precisely. And suppose Cesare, too, loves his country and its liberties. Suppose his goal is to make Italy so strong that she will be able to throw off the yoke of tyrants."

"His ways are vile," said Leonardo sombrely.

Machiavelli slashed at the air with an invisible sword. "In defence of one's country, all ways are good." His voice trembled. "Listen: the friar Savonarola was a saintly man. The people of Florence, therefore, appointed him to write their constitution and to preside over them. He tried, but he failed, mark you, because he was too gentle. Francesco Sforza was a cruel man, but under him Milan was safe. His son Ludovico, however, was not a cruel man, and where is he now? And his people, where are they? Under the French yoke. No, Master; the time for goodness and mercy will come only when the country is strong and safe. Meanwhile Cesare Borgia meets fraud with greater fraud, and dagger with more than dagger."

From the tent in the distance a figure in a plumed hat and spurs stepped out.

"O my Prince!" whispered Machiavelli. "Arise and deliver us from our slavery. What sacrifice of tears and blood would we not make for thee!"

Leonardo began to move towards his own tent. He stopped

and turned once more to the shivering scholar in the threadbare cloak. "You do not love truth and goodness as I do, Signor Machiavelli, for their own sake," he said. "I, too, am in the mood to prophesy." He pointed a long arm upward. "There shall hurtle through the air hosts of winged creatures who shall attack both men and beasts, and the work of men's hands will be their death."

He turned away, feeling lonelier than ever. "Do you not long for the saner air of Florence?" he asked.

The River

EARLY in the following spring Niccolò Machiavelli came one day to see Leonardo in his studio. He looked more fragile than when they had met at Cesare Borgia's camp. His face was more bony and his manner more restless. He was Secretary to the Council of the Republic of Florence, and the cares of his office seemed to be telling on him.

"The time is full of danger for us," he said gloomily. "Cesare Borgia is demanding tribute of us. He insists, moreover, that we allow his troops passage through our territories. If we yield, it will be the end of us. He demands that we recall the exiled Medici. He does not like republics and he would have us change our form of government. Well, we have been paying the French King for protection. He may save us.

"Oh, for a militia of our own," he went on, "where every citizen would fight for his home and country! No one would dare attack us then. As it is we have to stake everything on hired condottieri, and they are untrustworthy. I am urging our Government to organize its own militia. But what I've come to see you about is this. We are again fighting Pisa. There, Leonardo, you can help us. Help us to end the war quickly and victoriously. Otherwise Pisa may become the ally of Cesare Borgia. He would use her as a base of operations against us. Such is the miserable state of Italian politics to-day."

Leonardo had already set up his easel for the portrait of La Gioconda. Other commissions waited for his attention—one from the French Court, and one from the Duchess of Mantua, who had been begging a picture from him for fifteen years now—but he preferred to do the portrait of the merchant's wife. Something in the face of Madonna Lisa attracted him strangely.

He could not say what; something unfathomable, like shadows suspended in flowing water.

Machiavelli, who had been walking up and down the room, his long red tunic billowing behind him, stopped at Leonardo's work-table and picked up a sheet lying upon it. "Your bird, master, is real enough to fly." He put down the sheet. "Ah, how I envy you," he sighed. "In these tumultuous days, you are so calm. How can you disregard the clamour all around you?" He laughed nervously. "You have the secret of happiness, Master Leonardo. Share it with one who needs it sorely."

"Gladly," replied Leonardo. "It is a simple secret. In the realm of nature, my realm, all is peace and order, and I spend my days meditating upon its laws and its beauty. There, Signor, leave the chaotic world of man."

"Everyone to his taste," said Machiavelli. "The world of man has its laws, too. And it will be somewhat more beautiful if you help us to destroy Pisa."

"We do not have to destroy Pisa," he said to Machiavelli. "Let us take away her river. Then no supplies can reach her, and she must surrender."

"You do not often jest, Master Leonardo," remarked Machiavelli. "I speak in the name of the Republic."

"And I in the name of science. It is no jest. Turn the river Arno from its present bed, and you can cut off Pisa from the sea. You can do it by intercepting the river by a canal—two canals will be needed in this case. I can coax the river to turn into these new channels."

The statesmen raised incredulous eyebrows, but the word of the illustrious Leonardo and the urging of Machiavelli were endorsement of the plan.

"It is not a war measure alone," Leonardo pointed out. "The best thing about the plan is its possibility for peaceful trade. Even if we do not rob Pisa of her share of the Arno, the canal will be a rich investment. Alongside it merchants can build their mills and factories for grain, textiles, paper, and so forth. They would have water-power for their machines and a waterway for their commerce. But we shall have to build dams with flood-gates along the upper reaches of the river."

He threw a cover over the easel on which the shadowy depth of La Gioconda was forming, cleaned his brushes and put them away, and became the engineer again. The work he had induced the Government of Florence to undertake was vast in its scope. It entailed so much expense of labour that unless he cut it down he foresaw failure for the plan. Only one way was open, and that was through labour-saving machines. But here he found himself up against other obstacles. He could easily enough design the machines. But could he get them built in time? Could he induce the workmen to use them?

He designed an excavating shovel consisting of buckets attached to a jib. The jib was worked by a huge treadmill. As the worker paced the treadmill, the jib rose, carrying the buckets, which finally tipped some distance away. He designed a crane for removing excavated debris. The novel feature of this crane was that it consisted of a system of pulley cars which rode on an overhead trolley. Looking ahead to the time when the canal would be navigable, he also designed a system of canal locks on two levels. Boats were to be lifted or lowered from one level to the other by lifting or lowering the level of the water beneath them. This scheme made it necessary for him to evolve a suction pump, and he designed several. Meanwhile gangs of navvies were already working on the canal.

One day Leonardo announced that he would have to survey the upper basin of the Arno. The Government supplied him with an assistant called 'John the Piper,' and the two men left.

It was a relief to get away from the city, with its wearisome talk of war and the 'situation.' From the low hills of the Apennines, Leonardo refreshed his eye with long perspectives. On all sides Nature composed for him her scenes and fancies, in which the green wood, the gleaming thread of water, the stir of the city, the misty hill, each had its proper place on the invisible line that stretched to the vanishing point. Here was an affinity of birds and winds, of sun and water, of Nature and notebook. He had grown up among such affinities and such scenes, and those days in the valley of the Arno brought back to his mind the image of the boy Leonardo at Vinci, not far away.

John Cellini, nicknamed 'The Piper,' was a good companion.

He had one unfailing topic—the many wondrous deeds of his three-year-old son Benvenuto, already a genius, according to his father.

They sat on the banks of the river, John talking in an endless stream about the feats of little Benvenuto, Leonardo plotting the movement of the water. The wind piled waves against the bank, this way and that way. The water recoiled precisely that way and this way. Time without end the river flowed through the valley. If he could only lay bare the heart of the river as he once had laid bare the human heart. He had plumbed much in the mystery of the stream. He knew how to measure its speed by launching corks in it. He could regulate its speed and direction by changing the slope of its bed and by building dams. He understood the cause of waves and whirlpools: he could even create them by putting down rocks and dikes. Some day he meant to write a book on the nature of water, from dew to ocean currents. In it he would give practical advice on how to check floods, how to float logs down a mountain stream, how to siphon the stream, how to make it run mills and irrigate fields.

One night, when a round moon bathed in the river, John looked up at the sky and said: "To-night I do not see the man on the gallows." He laughed. "One does not know what to believe. Do those shadows on the moon show us Cain and Abel, a hanged man, or just a man's face? Come, what do you say, Master Leonardo?"

"Some say those spots on the moon are vapours. Others that the moon is made of crystal or alabaster, which gleams where the sun's rays strike it. Still others hold that the earth it is which casts shadows on the moon." Leonardo paused. "I think that the moon has its seas, like the earth. The seas reflect the sunlight. The dark spots are its land. I know that the moon, like the earth, has its day and night. I know that the moon and earth influence each other," he said.

The river made endless gnawing sounds, and the stars gnawed at the men on the bank.

"Yes," said John, "I know that the moon has its influence over us. And our fate is in the stars."

"I do not mean that. Astrology is a fraud. I mean that the



MONA LISA (c. 1503)



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STUDIES FOR MURAL OF "THE BATTLE OF ANGIARI" (c. 1503)

moon tugs at our seas, as the earth tugs at the moon's. I mean that the stars are like the earth, and the earth like a star."

So the hours went by like bubbles in the stream, and the wind carried off their talk. Leonardo showed John a petrified shell. "I have found this and many more like it," he said, "on the mountain-side. There were also some fossils of fishes' teeth, and other evidence."

"Evidence? Of what?"

Leonardo smiled. "If you are superstitious, this will be evidence of the power of the Zodiac. You know that many people, not able or not daring to explain these shells buried on the tops of mountains, say that they were formed in some mysterious way by the stars."

"Why should they not dare to explain them?"

"The truth will sometimes upset cherished beliefs. The truth about these shells does. It requires courage to throw away a cherished belief. To save it people would resort to any lie. When I was in Milan working on the Sforza horse, some peasants brought me a sack of shells and corals found on the mountains of Parma and Piacenza. I myself once found in the hills of Lombardy the form of a great fish. And I know of a man who, digging a well on his property, found the skeleton of a ship. There is no doubt in my mind what those things mean."

He made a sweeping gesture with his hand: "All this land was once under the sea," he said. "Once fishes swam on the very spot where now we see flocks of birds. The earth changes, changes. The sea withdraws, laying bare its oozing floor to the rays of the sun. Did not the Mediterranean, in a distant day, cover much more of Europe and Africa than now? Did not the waters then sink, leaving behind many large rivers? What then? These mountains, partly under sea, were the home of shellfish, which move so slowly that some could not escape the drought upon them. Along came the river floods, bringing layer upon layer of mud to bury them. The mud hardened. It became piled strata of rock.

"The story of change is plainly written upon our landscape. You can see where, on opposite sides of a river gorge, two hills facing each other have strata that match, as though the river had

sawn them apart. The buried shells, the seaweed, the tracks of worms, are uncovered by the sawing stream. Once these woods were not there. Once the hills were below the primordial sea."

Could he find the laws that governed this process of Nature?

The air had grown dark and a furious gale began to sweep down the slope. The ground beneath them seemed to be giving way as down the hillside the loose sand slipped, taking with it branches, stones, and tiny roots. A black sky opened to drive down a heavy, slanting rain bent by cross currents of wind. A thunderbolt split the air.

The two men were crouched under a huge rock. Shivering and wet to the marrow of his bones, John turned to the master. Leonardo had his sketchbook on his knee, and John could see him drawing heavy, jagged lines of rain, and soft misty forms, and straining trees. He was not shivering, and, if he was wet, he did not seem to mind it. The storm could not touch the man with a pencil.

"An idea for a picture," he was saying. "A picture of the Biblical Flood. I can see it: a rugged landscape, deep valleys. Bare mountains revealing the deep fissures of earthquakes. Swollen rivers leaping high. Driftwood. Men and beasts clinging to the tops of trees. You see before your eyes, John, how the earth changes."

Had they heard him talk by the river, the people of Florence would have thought him mad. Seeing him as he crouched under a rock, taming a storm with his pencil, they would have been sure of it.

War and the Lady

I AM afraid," said Niccolò Machiavelli to Leonardo, one day late in the autumn of 1503, "that the canal is not going at all well. The people are not supporting it. I am doing what I can for it, but in spite of everything there is bickering at every step of the way."

His grey eyes wandered about uneasily. With his long, flat nose, sunken cheeks, and narrow shoulders, he resembled a bird.

"It is simply too big a project for us. We suffer too much from indecision. It is the disease of republics."

"No," thought Leonardo, "it is not the fault of republics. The fault is mine. All my projects seem doomed. My Sforza steed, my *Last Supper*—they go the way of dreams in the light of day."

"The Council has sent me to engage you as an artist," said Machiavelli. "The danger to Florence from Cesare Borgia is past, as you know. The death of the Pope, his father, and his own illness have destroyed his power. Although he has recovered his health, he will be unable to recover his military might. Well, the Council wishes to celebrate our escape with a mural in one of the halls of state. They naturally turn to you."

Leonardo had never been so busy in his life. Despite the gloomy outlook for the canal, work on it was still going on, and he had to supervise it. A number of requests for pictures had come to him and he had promised to think about them. Besides the bespoken pictures, he had in mind one for its own sake, showing all the elements of Nature in a dramatic, earth-changing mood. He had made some notes during the violent storm in the hills above the Arno valley. Meanwhile he had taken the cloth cover off the portrait of *Mona Lisa* and, between times,

was trying to finish his book on flight—not only the book but, what was much more important, the machine.

“They want a picture commemorating the glory of Florence,” Machiavelli went on. “The theme they have chosen is the Battle of Anghiari. It happened in June of 1440 that at Anghiari our mercenaries defeated the mercenaries of Milan. The Council wants you to depict all our famous fighters. You should begin with the Milan general making a speech to his soldiers. Then show him mounting his horse. Show our own leader on a hill pointing out the enemy. Our leader clasps his hands in prayer. From behind a cloud Saint Peter appears and speaks. Then you can paint different aspects of the battle. I shall send you an account of it.”

The Council of Florence did not intend to put on a public wall a serious illustration of war. In the popular mind war was a pageant of fluttering pennants, shining armour, and heroes on noble steeds. The Lord himself was interested and took sides in the fray. A few men were hurt, even killed. Accidents happened in every tourney.

But the former engineer of Cesare Borgia knew war as it really was. He had witnessed a battle and written down his ideas on what a battle picture ought to show and the scenes he planned were no pageantry. Choked with dust and smoke they were, and the dust red with fire and blood. His scenes would show the frantic horses, one dragging the body of his master through the mud, another riderless. They would show the man who runs away with bent head and streaming hair, the man who raises his axe over a cowering figure. They would show the furrowed brows, the dilated nostrils, the mouth open to cry out. They would show the figure writhing on the ground in final agony, his eyeballs rolling, his fists grinding into his body. Such was the glory won at Anghiari or at any other battle, thought Leonardo. The meaning of any event, motherhood or battle or the betrayal of the Master, was to be found in the souls of the actors in the event. . . . And by the act they revealed their souls: the mother by her pathetic smile, Judas by his guilty start, and the fighter by his bestial madness.

As he had done in the case of the *Adoration* and later in the

Last Supper, Leonardo first went out with his sketchbook for the real models of his characters, men and horses. The white-faced man who runs away was to be found somewhere in the marketplace or round the cathedral, as also the man with veins bulging out on his temples and tense creases in the corners of his mouth.

The search for mortal agony took him to his old haunt, the hospital. There he often lingered with no thought of the battle picture, but to take up again his study of anatomy. He had left so many problems unfinished: the structure of the heart, for instance, and the nervous system; but when he lingered over the dissecting-table his hundred other ventures languished.

Morning, noon, and night there was the canal with its endless wrangle and chagrin; the workers wrangling with the soldiers, the taxpayers with the Government. In the midst of the confusion stood Leonardo with his diagrams of machines to speed up the work. Patiently he explained his new kind of block and tackle, or some bold design or rigging which could lift even a cathedral off its foundation. Would it not be wise to install it?

"Fantastic!"

"Good!"

"Let us consider."

And so on until the question was settled once and for all by a decisive storm which destroyed the diggings and the little efforts of men. The river Arno went back to its old channel and Leonardo to new work.

At home he tried to satisfy the demands upon him for pictures. The Duchess Isabella of Mantua, who still pursued him with her ambassador, now had her heart set upon a picture of the boy Jesus in debate with the doctors of the temple. To be rid of the ambassador Leonardo finally drew for him a rough sketch of a fair-haired boy with a globe in his left hand, the right raised in sign of blessing over a group of stubborn old men. The ambassador went away to report success in his mission, and Leonardo turned the sketch over to his students.

Patrons of art, when they did not want a portrait, ordered either a religious or a classical picture. For one client Leonardo made some sketches of Neptune ruling the waves. The sea gods and sea horses pleased the client; the visualization of wind over

water pleased Leonardo. . . . And the idea, though it progressed no further than the sketching stage, went into the portfolios of his pupils. So did his sketches for a picture of Leda and the Swan. But the sketch upon which his students pounced with amazement was that of a mysterious youth rising out of deep shadow. Only the head, right shoulder, and arm emerge. The youth inclines his curly head. He seems to beckon, and his mouth curves in a smile. Did the master really intend this charming pagan figure for Saint John the Baptist, as he said? What was the meaning of the smile? Why does the youth, as though in answer, point behind him into the shadows?

In the late afternoon La Gioconda came to sit for her portrait. It was the time of day when a soft, fading light flooded the studio. As Mona Lisa took her seat, clad in the simple costume Leonardo had ordered, she was greeted by the strains of a lute. Then Leonardo adjusted his easel, and added to the music his own voice. He spoke of many things: of the flowers he had put in bowls, of the moon's shadows, of the strange customs of men. He told stories and often Mona Lisa laughed with him.

All the time he watched her face, particularly the muscles round her mouth and eyes. Like a hunter setting his traps for some rare wild thing, he was trying to lure into Mona Lisa's face a rare mood hidden in the secret places of her being. He knew how to tame a stream of water. He designed machines that put to use the power of the wind and the forces of gravity. Now he was engaged in an experiment to control the mood of the human mind. In the hospital he had looked down upon the dissecting-table and asked himself: "Which are the nerves and muscles that control the feeling of hunger? Which the nerves and the muscles that govern the feelings of fear, of thirst, of fatigue?" As he looked upon the fair Mona Lisa he asked himself: "What can I do to bring out upon her face this mood I wish to paint? What stimulus of words or music will touch the muscles round her eyes and mouth?"

Day after day, for an hour or two before the shadows in the room became too heavy, he surrounded Mona Lisa with poetry, song, and rare talk. And his mind strained to catch the overtones registering in her face.

One day Niccolò Machiavelli dropped in to see him. "And the battle-piece?" he asked. "It is more than a year now, Master Leonardo. The councillors are beginning to grumble."

"Speaking of battles," said Leonardo, "where is Cesare Borgia now?"

Machiavelli smiled sadly. "In a Spanish prison. Who could have foreseen it? Yes," he muttered, "he was a great man and a model for princes."

Leonardo showed him his sketches of horses and soldiers. "I am ready to begin transferring these to cartoons. After that to the wall of the council chamber."

"The councillors have employed another artist—" Machiavelli informed him—"the young Michelangelo. He is to paint a second battle-piece on the wall opposite your picture. His theme deals with soldiers surprised while bathing. You know the story."

Leonardo nodded. It was a good theme for Michelangelo; he did nude figures superbly.

In the workshops of Florence they talked much about the competition of their two greatest artists, and the scene attracted all students of art. Leonardo was almost the only one who did not know of the competition. His energies were engaged in a different kind of competition. In the council chamber he heard the thunderous yells of battles and he pounded them out upon his palette of paints. He had depicted horses in the *Adoration* and the Sforza monument, but never did he understand them better than when he drew them upon the walls broken by the arched windows of the council chamber. Infected with the bestial madness of their riders, they plunged and reared and sank their teeth into one another's flesh. Above their heads and beneath the curves of their bellies he drew the twisting pattern of men and weapons. The wall lit up with the passions of rage and revenge.

The artists of Florence who saw the chalk cartoons of the *Battle of Anghiari* said excitedly that this was Leonardo's masterpiece and the greatest picture in history. The councillors were delighted. Leonardo's fresco, when it was finished, would be a public event.

One day the event became a public tragedy. "The battle

picture is destroyed." The rumour ran through the city. "Leonardo has destroyed it with his own hand. By fire—imagine! He built a fire in the room. One of his experiments. You know he is always experimenting. He is never satisfied, and this is the result."

It was true; the fresco was spoiled. Leonardo had not been satisfied with the tempera mixture used in fresco work because the colouring was too dull. A battle scene should stand out violently, and he experimented with varnishes until he found one that gave his colours the enamel-like brilliance he thought they needed. Painted in such tones, something like frenzy flamed in the eyes of the fighters, and the horses seemed to belch fire; but week after week that part of the picture already painted refused to dry. The sticky surface impeded his work. One fatal day he determined to dry the wall artificially, and he put a brazier under it and lit a fire. The drying seemed to be progressing satisfactorily, when suddenly, round the edges of the picture, he saw drops of paint thicken, swell, and begin to run in streaks. Before his eyes his months of labour melted away like a dream in the cold light of day. As he turned from the painful sight of destruction he recalled his experiment in mixing oil with tempera for the *Last Supper*, and his pain was very great.

The *Mona Lisa*—he still had that. It was not quite finished, but he would take good care that nothing happened to it. The *Mona Lisa* and his flying machine—he still had those. He must take good care of them. They were the full-length portrait of Leonardo da Vinci, the complete story of his travail, and the emblems of his victory in his struggle to understand Nature.

He stood aside, enjoying the effect of his *Mona Lisa* upon visitors. They saw the picture of a woman seated in an armchair on an open terrace high above the ground. Her rounded hands are crossed, and with her eyes and mouth she beckons and withdraws by turns. Behind her stretches a landscape of crag and winding streams.

The merchant and his wife stared long and silently at the portrait. The wife seemed to be saying to herself:

"Do I look like that? I think I look very attractive. I did

hope that he would give me a less matronly bosom. Yet it's very classic to be buxom, quite Greek. What lovely hands I have. That expression in my face is very deep, they say. What lovely hands I have!"

Her husband looked at the portrait, then at her, then at the portrait again. He was fifty-five and seemed to be thinking:

"What a beautiful wife I have. But what a strange expression Leonardo has given her. I do not understand it. I do not like it. After all, she is the mother of two children. That rather knowing look about her. They say that a portrait reveals the soul of the subject. I do not altogether like it. I have never seen such a portrait. It's not the sort of thing I had in mind. Not a single ring on her finger, nor a necklace even. Who could ever tell she was the wife of Francesco di Zenobi del Giocondo?"

The students of art are there with their sketchbooks. "How does he get that lustre and dewiness in the eyes; those delicate lashes; the flush of life in her cheeks and lips; all that rich, translucent background? No one but Master Leonardo has ever portrayed a smile, and not even he so sweet a smile," they say.

The more experienced artist contemplates silently. He starts. Do those eyelids really quiver? Does the smile mock him? Stranger than the spires and streams below her is the woman's smiling *yea-nay*. And he goes back to his own studio to try a portrait in the same style.

"No, Signore," said Leonardo to the merchant del Giocondo. "It is not yet finished. I cannot give it up yet."

When all the visitors had gone, Leonardo wrapped up the picture and carefully laid it away. He brought out the model of the flying machine. "The moment has come," he thought. "On the river up by the mills there is a good spot to test the model of the bird."

Man with Wings

AT last the moment had come.

The face that looked up at Leonardo from the clear water told him that. It was a large, rugged face. The message of haste streamed from its long beard like an echo of the rippling water. The alarm flashed out of the pouched pools of the eyes. *Delay no more!* He read the warning chiselled deep in the forehead and cheeks: *If your bird can fly, it must fly now. The year 1505, like other years, will soon pass.*

He rose from the bank and took the path up the slope to Fiesole at the top of the hill. The countryside spread in an ever-widening circle under him. Scattered upon the green slope were the villas of the grandees of Florence, and he picked out that of Lorenzo de' Medici, once Il Magnifico, which reminded him of his youth.

At the top of the hill, where the town of Fiesole began, he stopped. The valley rolled on every side of him; but towards the south-east his eye rested upon a formation of two low peaks with a gently rounded curve between. The natives called it Mount Ceccri because it resembled a swan. Leonardo sat down against the trunk of a tree with his eye fixed upon Mount Swan.

Yes, it was late. He had accomplished so little of all his schemes, he thought; and to live and die and leave no trace of himself was to have lived in vain. The thought stabbed him. What had he lived for? A swallow flew past him, tail down, to gain altitude. High above it a bird of prey glided with outstretched wings on a current of east wind. He was as conscious of its manoeuvres as if its body were his body. Yet if he died that instant, how many people would be aware of it? He must hurry.

The bird under the blue curve was slanting down. He knew

the tactics of a winged instrument coming to ground: small slant, swift descent. He understood. What else had he lived for but to understand all facts under the blue curve of heaven—not words in books, but natural facts?

"I have gone straight to the source of all truth," he thought proudly. "I have drawn power from my own soul and faced Nature always with a question on my lips."

His life had been an exciting conversation with Nature in which he found Nature responding not to the accents of words but to the stroke of the experimenter. Did he then understand Nature? The question tormented him. There was only one test for understanding. You understood a thing only to the extent that you controlled it. The bird gliding up above, wheeling, spiralling on the buoyant wave of air—could he make a model of it? Long ago he had made up his mind that the test of whether he understood flying was to be his flying machine.

Could he fly? It was not a simple matter of copying a bird's wings. That he had tried. The wings were to be attached to the flier, who operated them by hand cranks and stirrups, but it was not so simple. The wings proved to have too little power. And in flying, he had discovered, safety depended on great altitude, altitude depended on speed, and speed on power.

He followed the speck against the distant sky. "Yes, I can fly," he thought. "This time I have designed an efficient machine." His pursuit of flying after many false trails had at last taken the right turn. His years of study devoted to bird flight; his experiments to find those two crucial points in a falling body, the centre of gravity and the centre of resistance, had brought him a clear understanding of the trick of flying. Finally he had hit upon the right sort of mechanical gear to control the two crucial points, and a propeller to add power to his wings.

"I shall be known over all the world and for all time," he exulted. "The people will look up and behold a man with wings."

They would see only a speck hovering against the distant sky. And that speck would be he standing in his flying car. Fixed above him would be two pair of wings and he would be working

the cords and pulleys that controlled them. "Yes, the time has come and I am ready," he decided.

And if he had made an error; if, after he had taken off from Mount Swan, an error showed up, say in the drum round which the wing cords were wound? At Perugia, only two years before, an inventor of a kind of aircraft had taken off from the tower of a church and had crashed almost instantly. Nature punishes those who fail to understand her. If he had made an error he would die. But he had taken precautions by inventing safety devices—instruments, and a tent by which he could float safely down to earth.

"Fame," he mused. "Fame and everlasting glory will be mine." He drew out a sheet of paper and a pencil.

The great bird will take its first flight [he wrote] upon the back of the Great Swan, filling the whole world with amazement and filling all records with its fame.

In after years the people of Fiesole pointed to Mount Ceccri and told the story of a strange bird, huge and wondrously strange. One day the bird was seen poised on the summit of a mountain. Suddenly it glided into the air and vanished in the mist. So ran the legend. But Girolamo Cardano, whose father had known the famous Leonardo da Vinci, said that no man could make wings to fly; that Leonardo himself had tried and failed. Master Leonardo, who could have settled the question, was silent. He did not confide even in his favourite pupils.

What everyone knew was that in the very year of Master Leonardo's visits to Fiesole, King Louis XII of France induced him to return to Milan. Perhaps Leonardo never had the time to complete his flying machine. Perhaps . . . but nobody knows the answer.

It is a fact that he went into the service of the French Governor of Milan and moved back to the little farm Ludovico had once given him. Except for the added weight of seven years upon his shoulders, the people of Milan saw him unchanged. Likewise his mode of life was unchanged. He engineered canals, painted pictures, arranged tricky pageants for the pleasure of the court,

and planned another statue of a man on a horse. Rulers were all alike in their desires, whether Ludovico of Italy or Louis of France.

The people caught glimpses of Leonardo in the open country, following the movement of a bird or a stream. They came upon him in a lonely wood, brooding over seed-pods and worms, over rocks and shells. They saw him take note of a curl of smoke or a human feature. And often they could see him at the door of the public mortuary, with his dissecting instruments. His genius had many sides, like the sparkling facets of a jewel, and the eternal jewel in him was Reason.

But in the world of men reason is rarer than brute force, and Milan again became a theatre of war. Again Leonardo packed up, and, accompanied by a few pupils, went this time to Rome. The beard billowing over his chest was white, and he wore spectacles, the lenses of which he had himself ground.

Still no word from him about flying. In Rome he spent three years repeating snatches of his past. He set up a workshop and hired mechanics. One would expect to hear of his giving orders for a mysterious sort of sail or a wing for the blades of a propeller. But the orders Leonardo gave had nothing to do with flying. For the first time on record he made a thread-cutting machine and metal screws. He seemed to be interested in metals and experimented with alloys of metals. The Pope's treasurer found it difficult to manufacture metal money, and Leonardo invented a die for him. The marshland round the city of Rome was a source of pestilence, and he invented a pump to drain it. In his reading he came upon the works of a great philosopher of the fourteenth century, Roger Bacon, and he liked his books so much that he designed a printing press to disseminate them. Still no hint of the flying machine.

He was often seen in the public gardens, strolling with his favourite pupil, Francesco. One might expect that Leonardo would speak freely to Francesco. In the gardens he would speak to him of his own discoveries in natural law—of the arrangement of leaves and branches, of the effect of sunlight upon the growth of plants, of the rising of sap in defiance of the law of gravity by capillary attraction, of the age of a tree told by counting the

concentric circles in its section. He showed the young painter how to depict foliage clothed in light. He showed him the tones in shadows, and the scattering effect of dust upon sunlight. He probably spoke to him of the time when he threw weights down from the tower in Milan and thereby discovered that the rotation of the earth affects the line of falling bodies. But if he spoke of a flying machine, Francesco kept it secret.

The great bird will take its first flight upon the back of the Great Swan, filling the whole world with amazement.

Years later Francesco made out the words in a page of the notebooks his old master had bequeathed him. The words were written in the master's secret script, running from right to left. But the greater secret of what happened on the summit of Mount Ceccri was indecipherable.

In the year 1516 a new French king, Francis I, marching his troops into Italy, met Leonardo. One king was like another; Francis like Louis who was dead. Among his other conquests his Majesty won Leonardo's consent to go to France.

"One of my delights," said the King after Leonardo's death on May 2, 1519, "was to ride over to his castle at Cloux and listen to him talk. He knew more and was wiser, I think, than any man that ever lived." He made the remark to another famous Italian craftsman, Benvenuto Cellini, the son of John the Piper—once Leonardo's assistant in Florence.

In the castle at Cloux Leonardo passed his last days. The venerable old man, with the deep-set eyes and billowing locks, became one of the shrines of France. Aside from his court duties he gave all his time to his notebooks, which he was soon to bequeath to Francesco. The more than five thousand pages had to be sorted, arranged by subject matter, revised, and given a permanent shape. As he read through them the old Titan must have been pleased with all he had achieved, for he added the comment:

Thou, O God, dost sell unto us all good things for the price of labour.

It was not that he would leave many monuments. He kept with him the portrait of *Mona Lisa*, a cartoon of *Saint Anne* and

MAN WITH WINGS

the Virgin, and the *Saint John*. Little more. The *Last Supper* was steadily crumbling and the Sforza monument was a pile of formless clay. His other pictures were scattered, perhaps destroyed. Who would know them? His inventions were only machines on paper. His treatises dealing with all things in heaven and on earth were but random speculating and of none of his works would he ever say: "Good! It is finished." Others would have to realize what he had only foretold: an age of machines and power over Nature, an age of reason in the world of men.

The man with wings could never say of his work: "It is finished"—nor of his question: "It is answered." Whether moved to paint a picture or to build a flying machine, either desire led him back towards the root of things, and forward to all their possible shapes. In a universe one thing leads to another, and the search for the picture and for the machine is a searching without end.

All that we now know is that the man with wings climbed from the valley of the river up the slope of a low hill. His eyes were fixed on higher ground. And his hope was to 'take off' and to see the world spread under his lifting wing.

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